Derivatives and Economic Growth in South Africa: Lessons for Kenya

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Abstract

Kenya is now at advanced stages of introducing a derivatives market. Its aim is to enhance Kenya's medium-term growth prospects as outlined in the capital markets master plan 2014-2023. This study interrogates the effect of derivatives on economic growth and growth volatility, learning from the South African experience. The study also identifies some of the factors that drove South Africa's implementation of derivatives as a development tool - Some countries have enacted legislation for it yet have never transitioned to successful operations. The study paints a picture of the current global and regional view of derivatives and examines empirical evidence from previous studies. Using a GMM approach, the study finds no significant relationship between trading derivatives and economic growth in South Africa. Thereafter, economic growth volatility is modelled using the GARCH method and the effects of derivatives on that volatility are tested. No effect is found. The study finds that the derivative market in South Africa is not yet sufficiently developed to benefit the economy. Finally, the relationship between economic development and derivatives is appraised using a Granger causality test: this suggests that development tends to engender the evolution of derivatives in the long run.

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List of Abbreviations

ABS Asset backed securities

ADF Augmented dickey fuller

AIC Akaike Information Criterion

ARCH Autoregressive conditional heteroskedasticity

ARDL Autoregressive distributed lagged

BESA Bond Exchange of South Africa

BLUE Best Linear Unbiased Estimates

CBOT Chicago Board of Trade

CDO Collateralized debt obligations

CFD Contracts for difference

CLRM Classical Linear Regression Model

CMA Capital Markets Authority

ECM Error Correction Model

FRA Forward rate agreements

FSCA Financial Services Conduct Authority

FSS Financial Services Sector

GDP Gross Domestic Product

GEM Growth Enterprise Market

GMM Generalised Method of Moments

HAC Heteroscedasticity and autocorrelation consistent

IMF International Monetary Fund

IPO Initial public offering

JSE Johannesburg Stock Exchange

NCPB National Cereals and Produce Board

OLS Ordinary Least Squares

OTC Over the counter

PA Prudential Authority

SPV Special purpose vehicles

SRO Self-Regulatory Organisation

SSA Sub-Saharan African

CHAPTER ONE: BACKGROUND AND INTRODUCTION

1.1 Introduction

Derivative instruments have been in use since ancient times and have chiefly been used to manage risks among other objectives (Kummer Pauletto, 2012). For a long time, they have been a preserve of elite, sophisticated, advanced economies but their application in developing economies has accelerated in recent years, especially after the global crisis of 2007. The crisis had a contagion effect on several countries, making governments more risk sensitive and deliberate on risk mitigation strategies (Huwart Verdier, 2013). A lot of research done in its aftermath linked it to the unprecedented globalisation of finance (Lane, 2013). Such globalisation, with a small number of financial hubs led to a concentration of risk centres where most risky transactions occurred. Ambitious, perilous and unregulated products proliferated the market at the time but global interconnectedness was culpable for amplifying the crisis (Lane, 2013). Following the 2008 crash, risk management became more important, not only in financial hubs, but also in emerging and developing economies, especially those which suffered the adversity of contagion effects (Batten Wagner, 2014).

Views on derivative effects are divergent. Proponents focus on their useful contributions as risk-sharing mechanisms, providing entities with hedging tools against contingencies as well as providing better information on financial markets. The dissenting view focusses on the disadvantages linked with derivatives markets and their role in attracting speculators, increasing volatility in spot markets, and exacerbating financial crisis (Bujari et al., 2016) Bujari notes that there has been tremendous growth of derivatives in recent decades, and gains outweigh the disadvantages. He asserts that derivatives have a positive relationship with key macroeconomic variables such as GDP (Gross Domestic Product) and per capita income. The relationship is further emphasized and pronounced when you consider the size and liquidity of the market. As such, despite being widely linked to the financial crisis of 2007, there is compelling evidence that derivatives have the potential to drive economic development (Bujari et al., 2016).

South Africa, being a significant member of emerging economies (EG) is the only African nation with a derivatives exchange. The market has the widest offering of products in the world and is testament of the market diversification breadth (Hassan, 2013b). More importantly,

relative to other African countries, its financial sector is well regulated, although a lot remains to be desired. Proper oversight inspires confidence in the market. Both commodity and financial derivatives are traded with the main instruments being a wide spectrum of options and futures. The market has grown exponentially since its establishment and has resulted in huge capital inflows, thereby making South Africa an investment destination of choice (Aron et al., 2010).

1.2 Research Problem

Kenya's vision 2030 blue print identifies Financial Services Sector (FSS) as significant in achieving an ambitious 2030 target of more than 10% annual growth rate (GOK, 2007). This document cites capital market development as the main driver of savings and investment to achieve the medium-term goal. Consequently, the capital markets authority embarked on a series of reforms, consolidated in a master plan document running from 2014-2023, through which they hope to revamp and bolster the capacity of the market to accommodate the heightened expectations. Through the reforms, it is hoped that Kenya will move from a frontier economy and join the league of emerging economies and further entrench its position as the 'Heart of African Capital Markets'(CMA, 2016). It should be noted that in the classification of markets, there is no simplistic linear progression from frontier, to emerging and finally to a developed economy. However, some types of market infrastructure and institutions represent necessary conditions for development, but this should not be confused with fleeting exuberance(Schizas, 2012). The developments should be clear consistent and represent sustainable gains.

One of such planned reforms is the introduction of a derivatives market. Like many other Sub-Saharan African (SSA) countries, derivatives scene in Kenya is underdeveloped characterised by poor structural facilities, inaccessibility to trading platforms, poor trading systems, weak trading rules and until recently, the non-existence of a central counterparty (Chidaushe, 2018). This curtails the involvement of local and international investors in the market as they lack the means to diversify their portfolios, given periodic and erratic disturbances incident on the economy like unpredictable weather patterns, political instability, changing fuel prices etc. The intention to deepen the capital markets is timely as it comes at a time when developing nations' budgets are coming under increasing strain(Fölscher, 2007). With a surge in urbanisation,

populations demand more services whereas the tax bases remain unchanged or expand rather slowly. In the specific case of Kenya, the central government is progressively decentralizing functions without additional intergovernmental transfers leading to fiscal stress. At this point, it should be noted that the country attained a lower middle-income economy status in 2014, which puts the country in uncharted territory where aid and donor funding are fast becoming scarce. In recent years, Kenya has faced severe short-term instability and expenditure cuts because of the suspension of concessional finance and other aid flows from development partners after failing to meet fiscal and other policy targets(Fölscher, 2007). It does not help things that there is a shift in global political economy paradigms with the US having a more introverted foreign policy and storms rocking the European union, the most recent one being BREXIT. There is thus an obvious need to deepen the capital markets and let it be a primary financier of economic development.

While there seems to be a readiness for the introduction of a derivatives market in Kenya, questions abound regarding the specific impact of derivatives on economic development. There is need to study the effects and causal links of a derivatives market on key macroeconomic indicators. This study looks at the relationship between derivatives and economic growth in South Africa with an intention to abstract specific lessons for Kenya. The choice of South Africa is informed by the fact that it has striking similarities to Kenya. For example, both countries are highly dependent on primary production such as agriculture, although South Africa is also well endowed with minerals. Further, the 2 nations have a burgeoning middle class who drive imports, with both countries having balance of trade deficits. Like many emerging and frontier markets, deficits and public debts introduce currency risk. It is therefore not surprising that researchers have found currency derivative instruments more popular in developing economies, contrary to the case in advanced economies where interest rate linked instruments are most traded (Mihaljek Packer, 2010). Therefore, a South African case study will mimic the realities of Kenya more accurately, seeing as enough similarities can be drawn between them.

1.3 Objectives

This research aims to examine the developmental impact of derivatives market in South Africa with the intention of deducing key learning points for Kenya. To achieve the above broad objective, the following specific objectives will be pursued

1. Determine the effect of derivatives on economic growth volatility in South Africa.
2. Determining the effect of derivatives on South Africa's economic development and the causality relationship.

1.4 Derivative Instruments Defined

The term derivative means to get something from something else. In finance, derivatives refer to a broad class of instruments whose value stems from the price and or other related variables of an underlying asset (Vashishtha Kumar, 2010). This implies that the payoffs gotten from such instruments arise from other, more primitive assets, and their intrinsic value is closely linked to the claim the owner can trace through the instrument in the original/underlying asset. For this reason, they are otherwise known as contingent assets, as they are dependent on other assets.

These versatile instruments are capable of several functions and applications, risk management being the most significant. It is worth mentioning that risk management does not necessarily imply risk alleviation, but rather, it is an attempt to mitigate or scale down the effects of a risk, should it crystallise. Derivatives are pivotal in risk management through unbundling and transferring of risk between various parties (Kozarević et al., 2012). To illustrate how unbundling occurs, we must appreciate that an underlying asset for which a derivative instrument is written is a stack of risks. For example, a bond is a conglomerate of credit risk and interest rate risk. However, by buying a credit default swap (CDS), a holder insulates himself against one and not all the risks i.e. credit risk, hence risk unbundling. Through a combination of instruments participants can significantly immunise themselves against volatility, which in most cases is the epicentre of risks. Derivatives are also widely used for speculative purposes(Sundaram, 2012). Traders with enough skill and market technical know-how can take positions regarding the direction of the market, with an intention to make profits. While speculation comes across as an incidental application of derivatives, it is extremely

important in the ecosystem of a proper market. It functions as a 'lubricant' as it serves to inject liquidity in the market and assures trading counterparties.

Another application that gives derivatives an irresistible allure, is the role it plays in improving efficiency in trade. Investors and interested parties can take positions in the underlying at considerably low costs compared to the cash equivalents of purchasing the same. At best, there are zero costs involved as in the case of a forward or a future contract. Additionally, sometimes an investor could combine a pair of strategies so that he generates idiosyncratic positions whose costs of outlay net out and lead to a net low investment cost. For example, buying a call option and selling another at different premiums gives the investor an opportunity to net out the premium he pays with what he receives, thus creating unique positions that reflect his speculative bet or provide insurance when markets don't go as predicted (Wilmott, 1998).

Closely linked to market efficiency and the premium of liquidity is the benefit of price discovery and stability (Kolb, 2010). Derivative markets make it possible to consolidate all material information regarding an asset, at a relatively cheap cost and compacts it in a discernible price for the public. The market minimises information asymmetry and is self-correcting whenever deviations crop up. For example, through the futures markets, arbitrage opportunities are eliminated (Avellaneda et al., 1995). Whenever there is a gap between the future and spot prices, a self-correcting convergence between the two prices occurs, the mechanism of which leads to price revelation and its subsequent stability.

There are broadly three categories of participants in this market, strictly guided by the ends that each one of them hopes to achieve. First there are hedgers who hope to manage risks brought about by exposure to volatile assets and seek to reduce the effects of potentially adverse movements in future prices of assets. The main motive of a hedger is to introduce certainty in an uncertain environment, through buying or selling of securities intended to offset price fluctuations (Cheng Xiong, 2014). Second are speculators who bet on future price movements in given assets and are primarily driven by desire for profits. Finally, there are arbitrageurs who are equally profit driven, except that they shy away from taking on risk and seek to capitalise on imperfect information by taking offsetting positions in the same or competing assets in different markets.

Following from the definition of derivatives it is theoretically possible to write a contract on any asset as an underlying but in practice this is not the case. The commercial viability and justification of these instruments is firmly anchored on uncertainty, and as such, only assets

whose value is oscillatory, and volatile are preferred. This suits the investment profile and uses of the major participants in the market as discussed above. If an asset's value does not vary from time to time, then its value from a derivative perspective is zero as there is no impetus to bet on its future (Avellaneda et al., 1995). Some of the more popular underlying assets include: foreign exchange, bonds, shares and share warrants, equity indices, interest rates, treasury bills, money market products like deposits and loans, commodities such as coffee beans, grains, livestock, and precious metals such as gold, silver etc.

1.4.1 Classification of Derivatives

Derivatives can broadly be categorised based on the market where trade occurs, or on the nature of the underlying financial instrument. According to markets, there are listed/exchange traded derivatives and over the counter (OTC) derivatives. Listed derivatives involve the trading of highly standardized contracts through a central venue known as an exchange and typically the clearing and settlement or booking of transactions with a central counterparty (CCP) also known as a clearing house (Heckinger et al., 2013). The key advantage of listed instruments is that their high standardization facilitates trade and enhances market liquidity. In addition, the clearing house replaces bilateral agreements between trading parties to assume the role of a counterparty, and significantly reduces counterparty risk. All trades to an exchange are routed through a participant in the clearing house. The converse of listed instruments is OTC derivatives, which involves bilateral trades of customized transactions negotiated and booked privately between parties who are also naturally predisposed to counterparty credit risk (Heckinger et al., 2013). Based on the underlying, we have financial and commodity derivatives. Commodity derivatives have commodities such as metals, grains etc as the underlying, whereas bonds, stocks and other interest-bearing instruments are the contingent assets for financial derivatives. The above broad classifications can however be further subcategorised into four distinct and commonly used groups as either forwards, futures, options and swaps.

A forward contract refers to an agreement between counterparties; a buyer and a seller, who commit to specific terms of a trade to be executed at a known date in the future (Chisholm, 2011). Since execution of the trade is certain at the agreed date, a forward contract exactly fits the description of a delayed spot/cash transaction and is the simplest form of a derivative. The

simplicity becomes more apparent when you consider that the agreement is strictly over the counter and is founded on mutual trust between trading partners. As can be reasoned, given the extreme localization in dealings, forwards offer contracting parties great latitude to customize their trade parameters (Carter, 2007). The length of the contracts, as well sizes are dealt with discretionally between consenting parties. More than being flexible, the contract costs nothing to enter. On the flip side, partners face an inherent credit default risk in the absence of formal enforcement structures and are denied the benefits of a liquid market (Stošić-Mihajlović Zdravković, 2016).

Like a forward contract, a futures contract is also an agreement to buy and sell an asset on a future date at a predetermined price but is strictly traded on an organized exchange (Haugh, 2016). Futures evolved from forwards to plug the loopholes identified above. Trading them on an exchange implies that trading conventions such as size of a contract, maturity dates, and even the quality of the underlying are standardized. Because the exchange assumes the role of the counterparty, execution is guaranteed but unlike the forwards, traders are required to pay a margin upfront (Hirani, 2007). Further, the position of the exposure is marked to market, meaning that margin calls can be made to buffer up the collateral position. An obvious advantage of futures over forwards is that it imparts liquidity to the transaction. The most important futures contracts are equity futures, stock index futures, currency futures and interest rate bearing securities like treasury bonds and treasury bills (Vashishtha Kumar, 2010).

Options differ significantly from the above two classes in the sense that only one of the two contracting parties is duty bound by the agreement. As the name suggests, one party has the liberty to act or not to depending on whether his action benefits him or not. Formally, an option is a financial instrument that grants the holder the right but not the obligation to buy or sell an asset at a future date and at a pre-agreed price(Carter, 2007). These can further be subcategorized into call options and put options, in which case, a call option confers on the holder, the right but not the obligation to buy an asset at a given price on or before a future date, and a put option holder has the right but not the obligation to sell to another asset at a particular price, on or before a given future date. Noticeably, the duty-bound party in these transactions is at an obvious disadvantage. Consequently, he is incentivised with an initial margin, after which he undertakes to be a counterparty whenever it is convenient and beneficial for the opposite party. Given the initial premium payable, and the undertaking to guarantee a price, options function exactly as a form of insurance against unfavourable price movements in the primal asset. They can be exchange traded or Over The Counter (OTC). The exchange

traded ones are subject to standardised conventions whereas OTC instruments can be customised.

A swap is a contract between two parties in which they exchange already existent obligations, arising from other contracts entered into separately. More specifically, the parties agree to exchange a stream of future cash flows, with the agreement stipulating the dates for the cash exchanges and the method of calculation (Hull Basu, 2016). Swaps are premised on the principle of comparative advantage and serve very specific roles of transforming assets and liabilities by restructuring the way cashflows are received or paid. The principal amounts agreed on by the transacting parties are often notional because the focus is on the exchange of the cash flows arising from such amounts, but not the amounts themselves (Hull Basu, 2016). Illustratively, fixed interest payments on a notional loan amount can be conveniently exchanged for periodic floating rate interest payments. The most common types of swaps are interest and currency swaps, with interest and exchange rates being the base for which cashflow computation is based upon. Often, swaps are contracts for difference (CFD), meaning that at the point of settlement, only the difference is paid to the party with a net positive balance.

Traditionally, swap transactions have been agreed upon and executed OTC, which explains the little retail engagement in this space. The notional amounts are often high cash flow exchanges occurring over a long period of time (Hull Basu, 2016). Interested trading parties transact through intermediaries, which in most cases will also act as market makers considering that double coincidence of wants is rare. The entire execution of a swap deal is testament of the ingenuity in the theory of financial intermediation. As with all other OTC transactions, there exists an inherent counterparty default risk in swaps.

Finally, Credit derivatives are bilateral financial instruments used to manage credit risk exposure against a given asset e.g. a bond. One party (seller) undertakes to pay another for any impairment in the value of the reference asset, whereas the other party (buyer) undertakes to make periodic payments to the seller. Credit default swaps are some of the most popular credit derivatives. Needless to mention, there are other types of complex instruments, which are gotten from mixing these basic forms such as asset backed securities (ABS), collateralized debt obligations (CDO), Forward rate agreements (FRA) etc (Hull Basu, 2016).

1.4.2 Development of Derivatives Markets in the world

Hull(2016) claims that derivative markets have become increasingly significant in the last 30 years, sentiments which are also shared by several other authors who seem to insinuate that derivatives are a novel concept whose prominence has come to the fore only in recent years. This perspective is juxtaposed against a paradoxical view by some financial historians that insist derivatives are an antique product, the only novelty about it being the naming conventions. Ernst Weber (2009) gives convincing reasons why there is a dearth of research capturing the evolutionary process of derivatives. Chiefly, he alludes to the fact that earlier transactions left no paper trail considering that engagements started out as private transactions happening bilaterally over the counter. As a matter of fact, even today, the OTC market is still clouded with a shroud of secrecy and the task of extracting information therein has always proved to be an uphill task.

The other reason presented has to do with the evolutionary meaning of the word 'derivative'. It was not explicitly used in the elementary stages of the product, and even now when it is commonly used in contemporary finance, some authors still argue that it is defined defectively when one examines the wide spectrum of derivative products. For example, its popular definition as an instrument whose value depends on some underlying asset fails to capture weather instruments which really have no underlying asset. Weather instruments are written on the incidence of particular weather patterns. To support this argument, long before options were properly named as such and classified as derivatives, Thales who lived between 625 to 550 BC predicted a bumper olive harvest and took the opportunity to negotiate a right but not the obligation to hire olive presses in his region come autumn. He made a cash deposit to secure the commitments of the press owners and when the bountiful harvest materialised, he made money by leasing the presses out at higher rates (Kummer Pauletto, 2012). This is technically an option, traceable to early civilisation!

Derivatives first came into use as tools to secure the supply of commodities and issue farmers with insurance from crop failures (Kummer Pauletto, 2012). With the passage of time, they also became useful funding sources, before ultimately being used speculatively to make quick profits. While most transactions were over the counter, centres where people could exchange these promises emerged, and gradually there was a gravitation towards standardization. As early as 17th century, the Dojima rice exchange in Osaka was functional and facilitated the

trading of various primitive instruments. As the applications of commodity/agricultural derivatives became widespread, their usage became ubiquitous leading up to the establishment of Chicago Board of Trade (CBOT) in 1848 (Sundaram, 2012). The exchange has continued to flourish and is responsible for various commodity contracts today, not only in agriculture but also in metals and energy. Since the setup of Chicago Board of Trade, derivatives market is the fastest growing and largest market in the world. Interestingly, financial derivatives which have a much shorter history than derivatives have become more popular over time (Sobol, 2008).

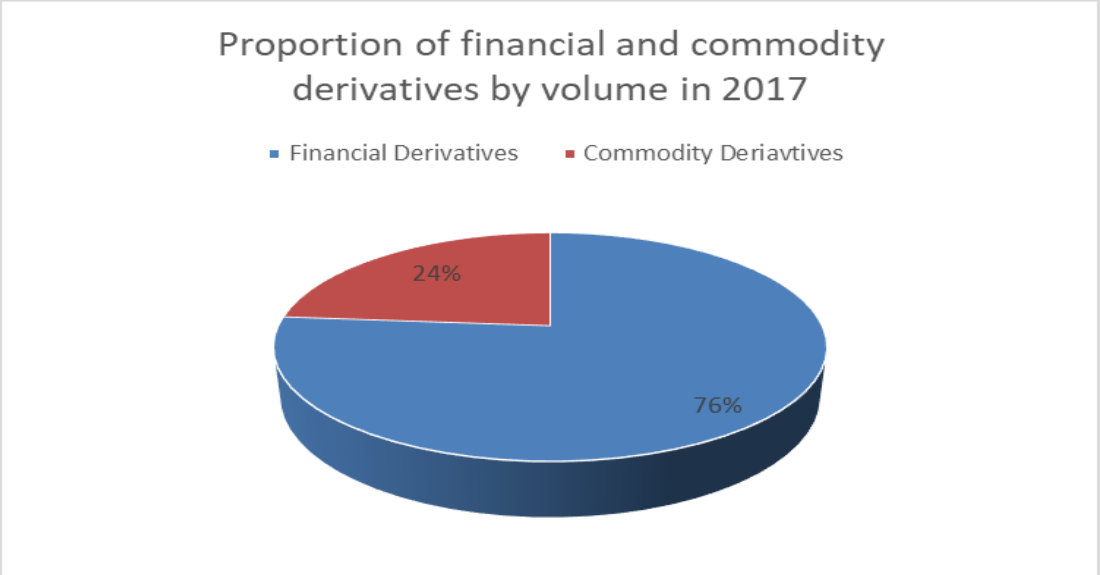

Figure 1: Proportion of financial and commodity derivatives by volume in 2017

Source: Author compilation with data from FIA

Financial derivatives became more relevant after 1970, when the Bretton woods system collapsed, shortly after the introduction of floating exchange rates as determined by demand and supply (Bryan Rafferty, 2005). With international currency volatility, governments began using interest rates to impress stability on their currencies, thereby introducing a level of indeterminacy in them. In the situation of uncertain interest rates, exchange rates and other variables such as share prices, it followed that the financial risk facing enterprises was eminent. A fashionable response to that, and true to the market driven capitalistic nature of contemporary finance, Chicago Mercantile exchange was launched as a first financial derivative market, with

several others following shortly after. In the 1980s, European exchanges followed suit and also launched derivative products.

Table 1: Rank of exchanges by number of contracts traded/cleared in 2017.

Rank	Exchange	Jan-Dec 2017 Vol	Country
1	CME Group	4 088 910 011	United States
2	National Stock Exchange of India	2 465 333 505	India
3	Intercontinental Exchange	2 125 404 062	United States
4	CBOE Holdings	1 810 195 197	United States
5	B3	1 809 358 955	Brazil
6	Nasdaq	1 676 626 292	United States
7	Eurex	1 675 898 310	Germany
8	Moscow Exchange	1 584 632 965	Russia
9	Shanghai Futures Exchange	1 364 243 528	China
10	Dalian Commodity Exchange	1 101 280 152	China

Source: Author's Compilation with data from FIA

The growth of derivatives around the world has been astronomical and has by far surpassed the stock and debt market. This growth is evident in both the OTC and exchange traded segments. Between 2011 and 2017, the lowest notional value for the OTC market was recorded in 2016 at $482 trillion, and a high of $710 trillion in 2013. In 2017, there was a marginal rise to more than $500 trillion translating to a market gross of approximately $ 11 trillion. By contrast, the global debt securities outstanding in the same year stood at slightly below $ 24 trillion whereas the global equity capitalization was valued at $ 82 trillion.

The table below indicates that over time, interest rate contracts are the most traded OTC instruments followed by currency contracts based on notional amounts. It is worth noting that credit derivatives have consistently been on a decline since 2011, plunging to a low of 9 trillion in 2017 from an all-time high of 58 trillion in 2007 during the global financial crisis. Presumably, the global perceptions on debt have significantly improved especially with actions taken by governments in the aftermath of the crisis. Commodity contracts are the least traded OTC instruments standing at slightly below $2 trillion in 2017, up from highs of $ 8 trillion in 2007, when they almost traded as much as equity contracts.

Table 2: OTC Derivatives Market 2011-2017

	Notional Amounts							Gross Market Value						
	Dec-11	Dec-12	Dec-13	Dec-14	Dec-15	Dec-16	Dec-17	Dec-11	Dec-12	Dec-13	Dec-14	Dec-15	Dec-16	Dec-17
All contracts	**647 807**	**635 681**	**710 092**	**627 786**	**492 536**	**482 422**	**531 912**	**27 295**	**24 952**	**18 810**	**20 830**	**14 487**	**14 948**	**10 956**
	647 328	635 210	709 629	627 375	492 215	482 150	531 552	27 284	24 942	18 785	20 804	14 467	14 936	10 940
Foreign exchange contracts	**74 286**	**78 059**	**78 492**	**82 062**	**75 953**	**78 781**	**87 117**	**3 294**	**2 954**	**2 457**	**3 128**	**2 712**	**3 324**	**2 293**
Forwards and forex swaps	37 542	38 602	38 396	41 174	39 923	44 226	50 847	1 370	1 215	941	1 331	1 037	1 515	1 111
Currency swaps	25 619	28 195	27 119	25 519	23 909	22 971	25 535	1 529	1 445	1 222	1 387	1 372	1 510	989
Options	11 124	11 260	12 936	15 333	12 093	11 533	10 679	395	294	294	409	303	299	192
Interest rate contracts	**533 313**	**521 253**	**600 821**	**519 607**	**395 138**	**385 514**	**426 649**	**21 078**	**20 023**	**14 689**	**16 128**	**10 525**	**10 636**	**7 579**
FRAs	54 805	76 091	81 973	83 614	60 520	63 183	68 334	204	172	209	257	191	243	112
Swaps	424 882	394 148	468 412	391 473	296 740	289 103	318 871	18 877	18 045	13 281	14 327	9 272	9 444	6 747
Options	53 621	51 010	50 075	44 202	37 628	32 823	39 112	1 998	1 806	1 199	1 544	1 061	949	719
Equity-linked contracts	**6 658**	**6 914**	**6 705**	**7 096**	**7 241**	**6 253**	**6 570**	**772**	**690**	**713**	**627**	**505**	**477**	**575**
Forwards and swaps	1 850	2 154	2 306	2 521	3 341	2 574	3 210	170	170	205	180	149	160	197
Options	4 808	4 761	4 399	4 575	3 900	3 679	3 360	603	521	508	447	356	317	378
Commodity contracts	**3 560**	**3 047**	**2 469**	**2 103**	**1 504**	**1 671**	**1 862**	**507**	**384**	**270**	**325**	**302**	**204**	**189**
Gold	801	760	493	457	391	495	520	74	53	50	36	77	34	21
Other precious metal	140	165	70	73	57	59	53	16	11	8	8	7	5	3
Other commodities	2 619	2 122	1 905	1 574	1 055	1 117	1 288	417	320	213	280	218	166	164
Credit default swaps	**29 511**	**25 937**	**21 142**	**16 507**	**12 379**	**9 931**	**9 354**	**1 633**	**891**	**656**	**596**	**423**	**295**	**304**
Single-name instruments	17 340	14 774	11 401	9 109	7 237	5 635	4 570	991	557	371	368	286	168	130
Multi-name instruments	12 171	11 162	9 741	7 398	5 142	4 295	4 784	642	334	285	228	138	127	174
Uncategorised	**479**	**471**	**463**	**411**	**321**	**272**	**360**	**11**	**10**	**25**	**26**	**20**	**12**	**16**

All values in billion USD

Source: Author's Compilation from the Bank for International Settlements

Table 3: Exchange-Traded Derivatives

	Exchange-traded futures and options						
	Dec 2011	Dec 2012	Dec 2013	Dec 2014	Dec 2015	Dec 2016	Dec 2017
Futures	**22 030**	**22992**	**24524**	**25580**	**25092**	**26169**	**33669**
Interest rate	21 806	22760	24280	25346	24857	25944	33381
Foreign exchange	224	232	244	234	235	225	289
North America	**12 719**	**12455**	**13748**	**15706**	**15647**	**17910**	**22222**
Europe	**6 106**	**7608**	**7970**	**7077**	**7086**	**5798**	**8700**
Asia and Pacific	**2 287**	**1925**	**1927**	**1775**	**1572**	**1568**	**1749**
Other Markets	**918**	**1004**	**880**	**1022**	**787**	**893**	**998**
Options	**31 663**	**26041**	**32935**	**32015**	**38394**	**41076**	**47315**
Interest rate	31 575	25936	32792	31871	38263	40954	47191
Foreign exchange	88	106	143	144	131	122	124
North America	**17 829**	**10349**	**17865**	**24688**	**26734**	**34521**	**36156**
Europe	**12 884**	**14266**	**14283**	**6771**	**11454**	**6114**	**10262**
Asia and Pacific	**16**	**3**	**5**	**19**	**14**	**13**	**22**
Other Markets	**934**	**1422**	**783**	**537**	**192**	**427**	**875**

All values are Notional Principles, in billions of USD

Source: Author Compilation from the BIS

For exchange traded derivatives, both options and futures had a combined outstanding notional figure of approximately $ 81 trillion in 2017 as shown in the table above. This is a small fraction when compared to the over $500 trillion in OTC markets. In terms of instrument valuation, futures have trailed options for the past 5 years. However, as was the case in the OTC market, interest rate linked instruments stand out as being the largest in both options and futures. An obvious and outstanding observation from the table above is the significance with which exchange traded currency instruments fade when compared to the OTC markets. In 2017, the forwards on OTC were more than over $50 trillion, which is in stark contrast to a meagre $289 billion in the futures market. It can also be seen that North America and Europe have the largest values of contracts.

The above conclusions from notional amounts change slightly when the volume of transactions is the basis for description. For example, over the past decade, equity dependent contracts have registered the highest volume of transactions, accounting for more or slightly less than 50% of the global volume on an annual basis as shown in the graph below. It also emerges that contracts written on indices have a higher turnover than on single stocks. It is worth noting that in 2008 and 2009, there was a spike in the number of equity contracts, and this is attributable to the scare that grabbed the financial markets in 2007. Whereas the notional descriptions put options instruments ahead of futures, the converse is true for volume and only goes to show that some exchanges have smaller size contracts, hence a large volume might have a corresponding low notional amount.

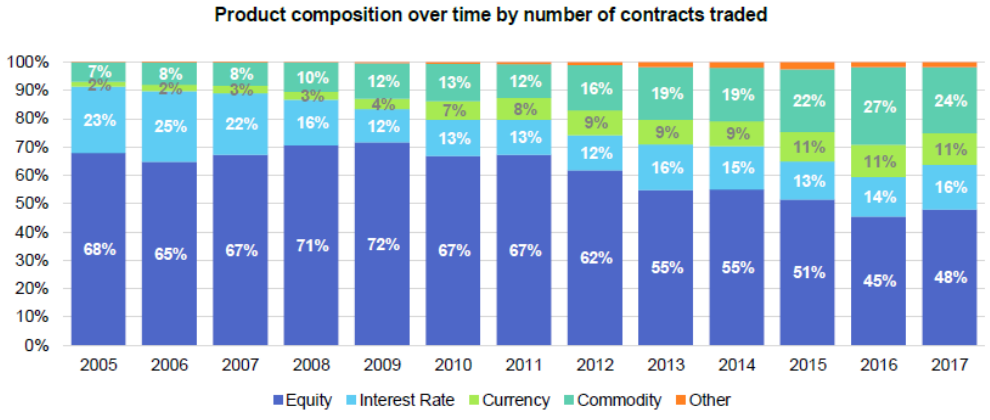

Figure 2: Graph Showing Product Composition by Volume 2005-2017

Source:2017 IOMA Derivatives Market Survey

1.4.3 Development of Derivative Markets in Emerging Markets and Africa

Derivatives markets have traditionally been identified with advanced economies, but in recent years especially post 2007/2008 financial crisis, emerging markets have increased the usage of such instruments and are taking on a unique identity for themselves (J. B. Singh Singh, 2018). For a long time, these markets used derivatives conservatively for price discovery, hedging, and risk management, but speculation has taken root in recent years. The product offering is the standard and conventional derivative products, although they shy away from more complex instruments, dealing mostly in the simple ones. This differs with advanced economies who deal widely in all levels of instruments. Another significant trend in emerging markets is that the size of the OTC markets is about the same size as the exchange traded market, whereas in advanced economies, listed markets are bigger and more liquid, accounting for nearly 2/3 of the total market (Sundaram, 2012).

A major characteristic of emerging markets is that they tend to specialise with instruments, so that certain countries are very good with certain aspects of the market, but only average or poor in others. For example, the most liquid fixed income contracts are traded in Brazil, Singapore and South Africa whereas equity index derivatives do much better in Taiwan, Hong Kong, Brazil, Korea and South Africa (Lien Zhang, 2008). More recently, commodity futures and options are gaining a foothold in India, Korea and China. Having said that, commodity markets are generally underdeveloped, thin and do not serve the purpose of price discovery efficiently (J. B. Singh Singh, 2018). For this reason, in some cases, price discovery still happens in advanced economies while ideally, it is supposed to happen in the producing markets.

In stark contrast to advanced economies who have more contracts linked to interest rates, currency contracts account for the largest volume of contracts in emerging markets and rightly so (Lien Zhang, 2008). Over time these economies have assumed an outward orientation to the world economy and have gravitated towards more integration with it. For example, China and Korea are big export players and their income is highly influenced by currency movements. Therefore, they are constantly faced with currency risk forcing them to take redemptive measures in the market. As such, currency products have evolved in depth and breadth to levels of requisite sophistication to manage the exposure. A final point to note in the emerging markets is that their contracts tend to be smaller than those in advanced markets, and this is

one of the reasons for the expeditious rise in volumes of trade. The pie chart below shows the volumes of trade recorded in 2017.

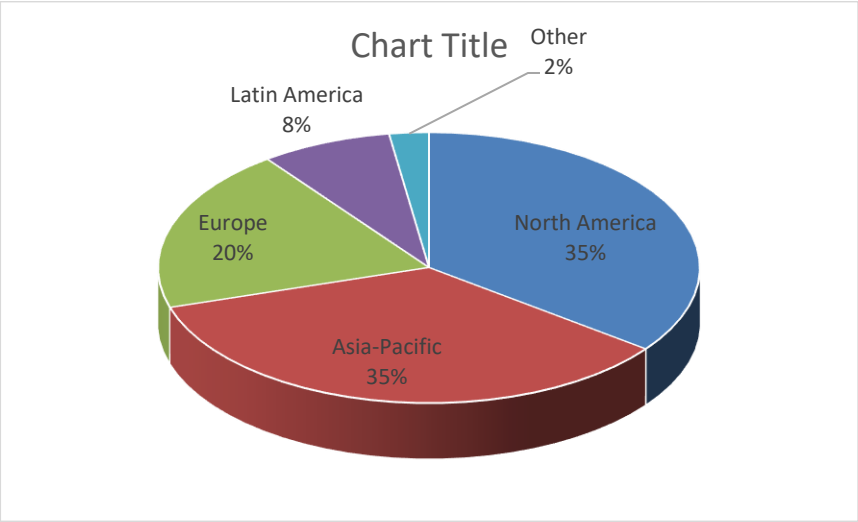

Figure 3: Chart Showing Volume of Transactions by Region in 2017

Source Authors compilation with data from FIA

As can be seen from the chart, Asia-Pacific countries are at par with North America in terms of volume although the notional amounts might vary. Most of the activity, however, happens in Singapore, Korea, Hongkong, China and India.

The Chart also shows that Africa has trading volume of less than 2% (Shown as 'other' in the chart above), with the most meaningful contribution coming from Johannesburg Stock exchange. The presence of only one successful derivatives exchange in Africa leads to the conclusion that the proportion of OTC market far exceeds listed products. Johannesburg stock exchange also happens to be the only exchange in the continent with a successful commodity derivative market. While the continent is littered with commodity markets, most only enable spot transactions and have little derivative activity (Mezui et al., 2013).

1.5 Description of the Financial System in South Africa

As of 2017, the GDP of South Africa was estimated at $ 349 billion with a population of 56 million people . The World Bank classifies it as an upper middle-income economy among other African countries of Botswana, Mauritius, Namibia, Seychelles and Gabon (WorldBank, 2016). Other than being a big player in manufacturing, agriculture and commodity spaces, the nation boasts of the best financial system in Africa and one of the more elaborate ones in the world. A plethora of financial institutions, both foreign and local serve the diversified economy, giving it a continental and world appraised sophistication. A distinctive characteristic of the entire industry is its fairly developed and effective regulatory environment which recently transitioned to a twin peak model (Treasury, 2017). Robust regulatory structures helped insulate the country against the 2007/2008 crisis, but the government sought to fortify any existent oversight loopholes by suggesting a move towards the now famous twin peak approach of regulation. This concept, first mooted in 2011, culminated in the establishment of a Prudential Authority (PA) and a Financial Services Conduct Authority (FSCA). A twin peak system is a two-pronged approach to financial regulation, with the PA established under the reserve bank to check the soundness and stability of the industry, and FSCA manning market conduct of financial players (Treasury, 2013). The old system suffered some frailties such as regulatory arbitrage, duplication of resources, and was in particular instances deprived of the mandate to reign on new products entering the market.

The banking scene in South Africa is an agglomeration of national, regional and international institutions which fuse together to form a sophisticated system. The number of registered banks has remained stable over the years as shown in the table below. At the end of 2017, there were 34 registered banks, 15 of which were local branches of foreign banks. Some 31 banks also had representative offices within the country to cater specifically for the specific interests of their home clients in South Africa (SARB, 2018). As at the time of writing this paper, 11 of the banks are locally controlled and the remaining 7 foreign controlled. The reserve bank licenses these institutions and undertakes to ensure that their activities are congruent with provisions of relevant law its Prudential Authority.

Table 4: Banking Entities Registered in South Africa

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Registered banks and local branches											
Banks*	19	19	18	17	17	17	17	17	17	17	19
Of which: banks under curatorship	0	0	0	0	0	0	0	1	1	0	0
Local branches of foreign banks	14	14	13	13	12	14	14	14	15	15	15
	33	33	31	30	29	31	31	31	32	32	34
Other											
Controlling companies	16	16	16	16	16	16	16	16	16	16	18
Banks in final liquidation	2	2	2	2	2	2	2	2	2	2	2
Mutual banks	2	2	2	2	2	3	3	3	3	3	3
Cooperative banks	0	0	0	0	2	2	2	2	2	2	3
Representative offices	46	43	42	41	43	41	43	40	40	36	31

Source: The South African Banking Annual Report 2017

Total industry assets amount to an approximate value of R 5 trillion, with the top 5 banks dominating ownership. Standard bank, FirstRand, Absa, Nedbank and Investec are responsible for a joint ownership of 90%.

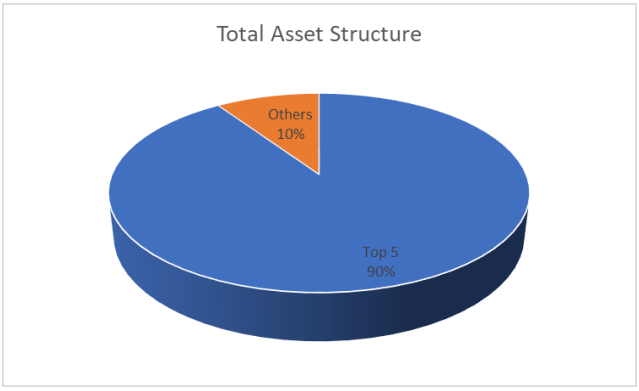

Figure 4: Chart Showing Total Bank Asset Structure in South Africa

Source: Author's Compilation with data from Annual Banking Report 2017

1.5.1 Overview of the Capital Markets

The highlight of South Africa's capital markets is Johannesburg Stock Exchange (JSE), founded in 1887. It started out with an open outcry system until 1996 when the automated trading system was introduced. Since then it has grown in leaps and bounds and is currently the 19th largest exchange in the world by market capitalisation ($ 1.11 trillion) indisputably making it the largest exchange in Africa (JSE, 2015). JSE operates on an SRO (Self-Regulatory Organisation) model and is responsible for oversight of its members. It is segmented into 3 markets namely: The Equity market, Debt market and derivatives market.

The equities market comprises of a main board and an alternative equity exchange; Altx; providing investors with a wide variety of investing opportunities. A sizeable number of firms are cross listed in various exchanges across the globe. Equity products include, primary and dual listed ordinary shares, depository receipts, preference shares, real estate investment trusts, warrants, special purpose acquisition companies, structured products, and other exchange traded products like exchange traded funds and notes. Presently, listed securities in the market exceeds 800 with over 400 companies listed in both the main and alternative segments (JSE, 2017).

The debt market of JSE is the largest in Africa, both in liquidity and market capitalisation. It acquired the Bond Exchange of South Africa (BESA) in 2009. At the end of March 2017, there were roughly 1690 debt instruments, with a market value of R 2.4 trillion (Treasury, 2017). More than half of the debt is placed by the government with the rest being placed by state owned companies, banks, corporates and other African countries. The instruments thus fall under the government and corporate bonds, as well as the Repo market. For government bonds, a total of 8 banks form the primary dealership side of the market, with the other interested players trading on the liquid secondary market. Of the total trading volumes recorded in the debt market, the repo market contributes significantly, accounting for over 70% of the transactions (Treasury, 2017). Closely linked with the bond market is an active interest rate market with products such as floating rate notes and commercial papers.

The derivative market in South Africa is the most innovative and fastest growing section of capital markets (Hassan, 2013a). Both exchange and OTC contracts are traded. Listed contracts include commodity and financial derivative instruments which are based on, equity, interest rate and currency derivatives. They include, index and single stock options and futures,

contracts for differences (CFD) traded on the exchange among other sophisticated contracts. This wide offering makes SA rank higher than any other country in terms of product line per exchange, as shown in the figure below.

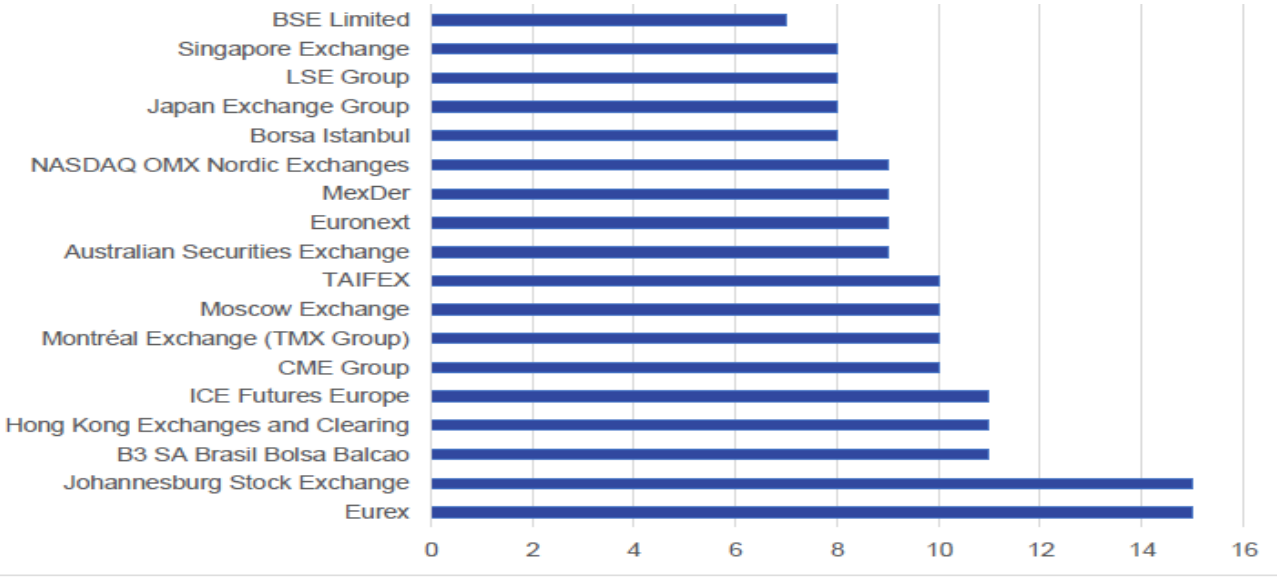

Figure 5: Number of Product lines per Exchange in 2017

Source: World Federation of Foreign Exchanges

The broad offering above should not be confused with depth. The exchange is among the top 20 exchanges by volume, but when compared with other top league exchanges, its volume is meagre.

OTC market in South Africa, like everywhere else in the world, is bigger than the listed market (Treasury, 2009). It is made up of bilateral deals and agreements between participants and allows extensive customization of contracts. The main participants include the big four banks together with international banks with local operations. Foreign exchange contracts are traded more than the interest rate ones, consistent with other emerging markets. This is not unexpected as there is a greater exchange rate disturbance, creating a need for hedging and attractive prospects for speculation (Hassan, 2013a). As has been mentioned, most OTC markets are unregulated, but following the crisis of 2007/2008, the Reserve bank ordered all banks involved in asset securitisation activities to furnish it with a report of the same. There was a real concern especially with exposure to credit derivatives like default swaps, which were believed to be causative of the global crisis. In the immediate aftermath of the global crash, the central bank

conducted a market soundness survey, the report of which indicated that South Africa's experience of securitisation was not as complicated as the advanced markets considering that securitised assets followed a similar credit approval process as banks followed when determining their own credit exposure (Kennedy-Palmer, 2015). Nonetheless, recent legislative development has not only seen the introduction of a consolidated regulatory approach, but also a requirement that JSE members report their OTC positions to estimate market risk.

Notably, the credit derivative scene is one directional, in the sense that local banks sell protection(insurance) to foreign banks and buy it from local participants such as insurance and asset managers. This means that Local banks just link international players to local markets while significantly limiting their hedging and speculative activities. Majority of the default swaps are single name but there are also a few basket ones (Kennedy-Palmer, 2015).

1.6 Overview of Kenya's Financial System.

Kenya has a GDP of $ 74.938 billion as of 2017 and has a sophisticated financial system relative to most countries in sub-Saharan Africa. The country is regarded as the economic power house of East Africa and has been the biggest economy in that region for a long while, until the recent rebasing of Ethiopia's economy. With a GDP per capita of $2999, Kenya attained a lower middle-income economy status in 2014, shortly after conducting an economic rebase (Deloitte, 2016). The financial system is composed of a vast network of banks, non-bank institutions and a stable securities exchange.

A convenient point of departure in examining the system frameworks in Kenya is to look at oversight institutions established to ensure the integrity and credibility of the financial ecosystem. The government, through the ministry of finance has mandated the following five institutions to regulate financial markets. i.e.

1. Central Bank of Kenya- Supervises the Banking Industry
2. Insurance Regulatory Authority-Supervises the Insurance Industry
3. Sacco Societies Regulatory Authority- Supervises deposit taking Savings and Credit Cooperative Societies
4. Retirement Benefits Authority-Supervises pension schemes and retirement benefits sector

5. Capital Markets Authority- Supervises capital markets institutions, activities and products

As a regulator, the Central bank of Kenya sets limits, requirements and prudential guidelines to guide the conduct of its licensees as well as facilitates national and cross border payments. It is also concerned with broad macroeconomic stability through monetary policy. Beyond licensing commercial banks, CBK licenses other non-bank institutions such as credit reference bureaus, forex bureaus and money remittance providers. By the end of 2017, the country was served by 43 banking institutions, of which 42 were commercial banks and one mortgage finance institution. In addition to these, there are other non-bank financial institutions such as representative offices of foreign banks, credit reference bureaus, money remittance providers etc (CBK, 2018a).

The government of Kenya has majority interests in only three of the 43 institutions, translating into a public ownership of only 4%. The remaining 40 institutions are privately owned, thus clearly indicating the dominance of the private sector in the banking industry. Furthermore, local investor participation is prominent as evidenced by the ownership structure in the remaining 40 firms. 65% (twenty-five banks) are locally owned while the remaining 31 % (15 banks) are foreign owned. The above proportions demonstrate the aggression of local investors and their dominance in this industry, but it is also notable that the market is not only limited to local players but has attracted and is open for international players as well as shown by the presence of foreign representative offices.

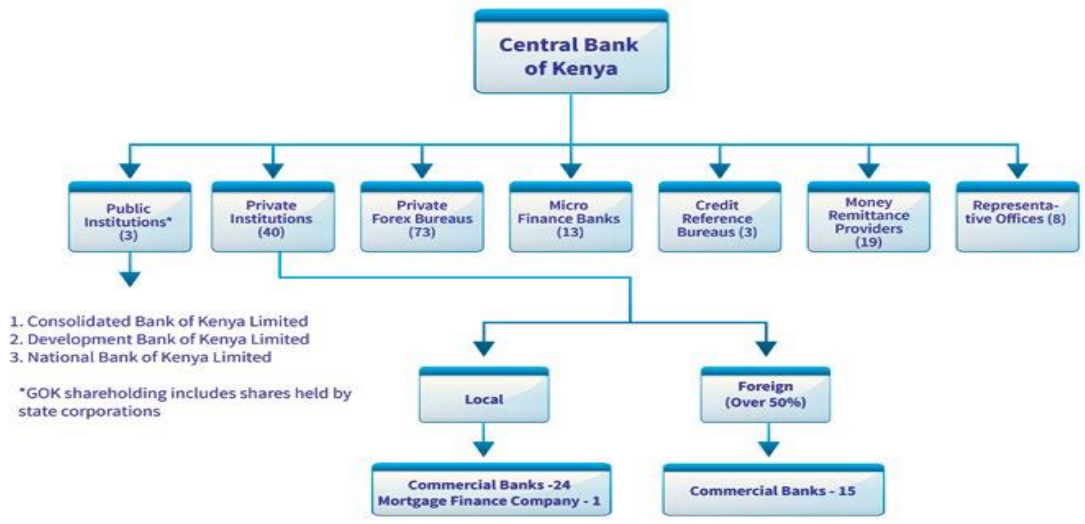

Figure 6: Kenya's Banking Sector , Source: Central bank of Kenya: Bank supervision report 2017

The net assets in the past year (2017) totalled Kenyan shilling (Ksh) 4 trillion with local private banks taking the lion's share of that, with a combined ownership of about 65%.

Table 5: Showing Ownership and Asset Base of Commercial Banks (Ksh. M)

Ownership	Number	% of Total	Total Net Assets	Of Total
Local Public Commercial Banks	3	7.5%	139,718	3.5%
Local Private Commercial Banks	22	55.0%	2,592,294	64.8%
Foreign Commercial Banks	15	37.5%	1,270,729	31.7%
Total	40	100.0%	3,695,943	100.0%

**Charterhouse Bank, Chase Bank and Imperial Commercial Banks which are under statutory management have been excluded.*

Source: CBK 2017 Report.

The central bank categorises banks into three tiers depending on their capital base. Tier 1 banks are the top brass, old and capital-intensive institutions. Currently, there are 8 tier one banks. The medium sized banks fall under tier 2 and these number 11. The smaller banks make the third tier and they are 21.

Table 6: Commercial Banks Market Share Analysis

Peer Group	Weighted Market Share	No. of Institutions	Total Net Assets, (Ksh. M)	Total Deposits, (Ksh. M)	Capital and Reserves (Ksh. M)
Large	65.98%	8	2,640,684	2,019,840	414,894
Medium	26.10%	11	1,052,969	787,147	171,527
Small	7.92%	21	309,088	219,438	57,768
Total*	**100.00%**	**40**	**4,002,741**	**3,026,425**	**644,188**
** Charterhouse Bank under Statutory Management and Imperial Bank & Chase Bank under Receivership have been excluded*					

Source: CBK

As can be seen from the table above, tier one banks have a joint market share of approximately 66% whereas 21 banks classified as small own approximately 8%. Banks contribute 7% of GDP in Kenya and form the largest portion of the financial sector. Towards the end of 2015, the Central bank appointed a new governor, who has since instituted several reforms to fortify the capacity of existing banks and also to revamp their risk management ability. This industry

shake-up has seen two mid-tier commercial banks put on receivership so far (Gathaiya, 2017). The waves of regulatory crack down have led to banks making more prudent provisions for their risk exposure.

Another recent development is an interest rate cap legislation passed by the government on suspicion that commercial banks were making excess profits at the expense of the banking population. The capping curved out a portion of bank profits and for a while, there had been confusion and uncertainty regarding the future of banking. However, banks have since continued to diversify, and have become more aggressive in their product offering to retain their profit levels. Consequently, bancassurance is on the rise, with banks diversifying into insurance, brokerage and deepening consultations. In a recent central bank report (2018b), the government has come to appreciate that the rate capping has done more harm than good to the economy. Notably, there has been some sectoral segregation with some sectors not getting adequate funding from banks who have persistently hiked their service fees and focussed more on alternative non interest related incomes such as investing in government papers (CBK, 2018b). The capping has effectively marginalised informal enterprises, as banks prefer to lend to low risk formal sector players. Given this viscous interaction between banks and economic agents, it does not come as a surprise that the conduct of monetary policy is undermined. The central bank has now joined the national treasury, world bank and sections of the private sector in agitating for a repeal of this piece of legislation.

The major non-bank sectors include an elaborate insurance industry and pension sectors. On the insurance front, the Insurance Regulatory Authority is the oversight body, controlling 55 insurance companies. The insurers have a presence in all insurance sectors, ranging from life, to property and even reinsurance. An idiosyncratic feature Kenya's financial industry is the extensive use of mobile money and mobile banking. Through mobile banking, financial literacy and inclusion levels have gone up on a year on year basis. In 2016, the financial access survey indicated that only a paltry 15% of Kenyans lacked financial access (Finacess, 2016). Mobile banking and mobile money have penetrated the banking, insurance and capital markets, best exemplified by the issuance of government paper through mobile phones in 2017 (Ndung'u, 2018).

1.6.1 Kenya's Capital Markets

Kenya has a sophisticated capital market with the apex institution for oversight being 'Capital Markets Authority' of Kenya. There exists a vibrant stock exchange and a central depository and settlement corporation. The major products of the market are bonds and equity securities. Equity securities include company stocks, Real Estate Investment trusts and exchange traded funds. The bond market involves active participation in government debt as well as private sector corporate bonds.

Through the capital markets space, there have been a series of successful initial public offerings at the exchange, which incidentally have always been oversubscribed by investors. In 2006, Kengen Company was able to raise $ 295 million whereas Safaricom limited was able to raise $ 833 million in 2008 in an offering that was oversubscribed by 532% (Joseph, 2016). This is an indication of investor appetite and a maturing industry. Activity has also been witnessed in a myriad of rights and bonus issues as well as other forms of corporate restructuring as in mergers and acquisitions.

Currently, there are 65 listed firms with a daily trading volume of about Ksh 800 million and a market capitalization of nearly Ksh 2.5 trillion (NSE, 2017). 11 of the listed companies are banks and they continually post impressive results contributing significantly in terms of market capitalisation. As recent as 2016, the exchange bolstered its systems to perform more sophisticated functions. For example, the new system allows online trading of debt and is integrated with the settlement system at the Central Bank. Its other features include capability to support market making as well as reporting of activities that happen over the counter for settlement purposes. The systems upgrade has invigorated the bond market which incidentally is bigger than the equities market, unlike the case in most economies.

In order to accommodate fledgling companies, the exchange has a Growth Enterprise Market Segment (GEMs) through which budding companies can list with some compromises on listing requirements. This category allows for either an initial public offering (IPO) listing, or listing by introduction. Another important development by the exchange was the 2014 demutualisation process and subsequent self-listing of the company (Murungi, 2017). Murungi (2017) observes that demutualizing the exchange had a somewhat positive impact on its financial performance, through increased market capitalisation, increased listings and introduction of innovative products. Riding on better trading technologies that followed

ddemutualisation, the regulator embarked on a series of market reforms aimed at transforming Nairobi into a financial hub and launch Kenya into an emerging economy. These reforms were documented in a 10-year capital markets master plan running from 2014-2023 and among other things, make provision for direct market access, introduction of securities lending and borrowing, securities short selling, derivatives etc. Regulations have been evolving side by side with market developments through a comprehensive participatory methodology that involves industry players and thought leaders. The Central Depository and Settlement Corporation has also undergone a systems improvement to accommodate changing activities in the market with the latest system upgrade occurring in 2016. The new systems are more sophisticated and have been procured with the intention and anticipation of accommodating settlement of derivative contracts, once the market is installed.

From the narration above, it emerges that Kenya and South Africa have some similarities and some notable differences. Both of them appear to have the same banking structure, where a few top banks control the biggest portion of the market. However, Kenya seems to have a lot more banks at the bottom unlike South Africa. While both of them have relatively successful exchanges, product breadth and depth is bigger in South Africa than in Kenya. Kenya's paltry 65 listings compare dismally to the over 300 listings at JSE. However, the basic framework and structure remains the same, even to the extent of providing for alternative listing segments for medium sized corporations. Regulation presents a clear cut difference between the two markets, with South Africa having made a recent switch to a twin peak regulation. Though the benefits may not be apparent in the comparison, Kenya's banking system is more liberal and has fewer exchange controls than South Africa's. This discussion will be revisited in the latter sections of this study.

CHAPTER TWO: LITERATURE REVIEW

2.1 Financial Development and Economic Growth: Theoretical Framework

Progress in finance takes on different forms and is often labelled in a variety of ways. For example, financial market development, financial sector/systems development, financial liberalization, or even financial intermediary development (Pillay, 2013). While there exists slight differences in the intended meanings of these terms, they are mostly used interchangeably. More formally, Colander (2010) defines financial sector as a market for the exchange and creation of money, bonds and stocks. Chami improved on this definition by incorporating other segments such as bonds, loans, equity and derivatives markets, suggesting that a comprehensive discussion on the financial sector involves a wide spectrum of significant subsectors (Chami et al., 2010).

Most researchers generally concur in the subsistence of a relationship between finance and economic growth as can be traced to the seminal work of Schumpter and Keynes who somewhat theorized similar ways through which developments in finance influence economic activity, (Nasica, 2002). The pair emphasized that dynamic aspects of an economy are closely linked to development of finance especially in the innovation of credit. Subsequent researchers have continued to impress on this relationship but differ significantly in the way the two influence each other as well as the manner and direction of causality (Caporale et al., 2009).

Robert Solow discounts the role of finance in growth with his argument that economic growth is a result of technological progress as opposed to capital or labour growth (Solow, 1956). He assumes that with constant returns to scale, growth in output mimics the combined growth of capital and effective labour. In addition, capital is presumed to have diminishing returns which means that at a given point, increases in capital converges to a saddle point of no growth. This approach implies that since financial systems only serve to grow capital by way of pooling household savings, and since capital then approaches a balanced growth path at which no more growth is possible, then the role of financial systems in economic development is negligible and hugely discounted. For a long time, the above view was dominant and economic growth was solely attributable to technological progress (Baluch Ariff, 2007).

The more recent perspective on finance-growth nexus consists of a significant departure from the traditional assumptions as articulated by Solow (Boyd Prescott, 1986). Romer, being one

of the proponents of the new school of thought proposed an alternative model with increasing returns to scale for capital, and without any upper limit on output (Romer, 1986). This new thinking is embodied in recent trends where capital injections in economies are persistent, combined with a growing demand for foreign direct investment. Financial innovation and development are highly intertwined in this new model because it plays a crucial role in the process of capital creation. Boyd and Prescott (1986) emphasize on the role of intermediaries in resource allocation; a concept that was refined by Levine through his 'theory of Productivity growth' (King Levine, 1993). It is worth mentioning that when reconciling the effects of financial development and economic growth, substantive literature on growth accounting suggests that the accumulation of physical capital does not necessarily translate to long run economic growth (Jorgenson Jorgenson, 1995). As such, financial intervention should be deliberate on fostering productivity growth.

Productivity growth is a sum total effect of rational investment decisions through the financial system and involves evaluation of costs and benefits (King Levine, 1993). Financial systems participate actively in productivity growth through evaluation and management of investments and channelling of resources to the most productive areas. In summary, the main focus of financial market development in modern day is to ease market imperfections arising from costs and uncertainties (Levine et al., 2012). For example, it reduces information asymmetry between parties, lowers trading and transaction costs and is useful in risk management as is the case in derivatives .

An important debate about finance-growth relationship is the direction of causality. A segment of researchers have theorised, and empirically proven that the relationship flows from financial development to economic growth. This implies that improvements in financial systems precede real economic development and growth (Yang Yi, 2008) . Such a pattern is typical of a supply-leading phenomenon, where finance is an antecedent of demand for its services. Through mobilisation of savings and the subsequent redistribution and allocative function, financial services bring about growth where there was none or serve to amplify the existing one. The opposing set of theorists believe that economic growth is a precursor to financial development, an argument supported by Jung (1986) and Goldsmith (1969) exemplifying a demand-following phenomenon. In this case, growth has an inducing effect on the demand for finance. The inducement triggers a supply response.

A more fascinating and less popular proposition asserts that finance and economic growth reinforce each other in a two way structure (Ismail Masih, 2015) . The reinforcement can occur in either one of two ways. The first is a simultaneous growth scenario, where the two sectors expand while being mutually dependent, and the second and more plausible explanation considers the stages of development (Musamali et al., 2014) . Early in the development process, finance is believed to cause economic growth through capital accumulation and triggers real expansion on the real sector. On the other hand, growth causes financial development in later stages of development when expanding economies begin to require finance to fund their expansion (Patrick, 1966). The more rapid the expansion, the faster the demand for financial services. In an unsettling rejoinder to the above theoretical propositions, Kargbo and Adamu (2009) posit that there is no consensus on the appropriate indicator of financial development and the direction of the relationship.

Osazevbaru (2014) describes volatility as a measure of price variation of a financial asset over time. He further states that it is essentially concerned with dispersion and not so much the direction of the changes. Volatility is useful in explaining cross sectional returns and is the fundamental risk facing investors holding or intending to hold market portfolios (Malkiel Xu, 2002). Given that uncertain price changes affect the perceptions of investors and investments, there is a bulge of emergent literature seeking to isolate the effects of volatility on economic growth. Ramey (1995) theorized that volatility can have a positive and negative relationship with economic growth. In a case where investment is not reversible, a rise in policy uncertainty would lead to reduced growth, hence negative relationship (Ramey Ramey, 1994).

A negative relationship could also arise if the investing population demands a higher compensation for the risky/uncertain operating environment. On the converse side, an uncertain environment may lead to higher precautionary savings and considerably grow savings and increase average investments. This hypothesis was corroborated by Kumar, who empirically proved that high stock volatility is associated with low economic growth and the converse is true (Kumar Tamimi, 2011). To ensure that the preceding result does not only hold true in micro aspects such as stock volatility, Hakan et al (2012) did a similar experiment at the macro level, while testing the effect of quarterly volatility in Turkey and obtained similar results.

From the argument above, we can deduce that if growth is suppressed by volatility, then the introduction of a risk management system/factor unlocks growth and development. Derivatives' most valued contribution in finance and hence its desirability, is its ability to

manage risk by introducing certainty where none existed. It unbundles specific risks and provides a framework through which those risks can be traded in their own right (IMF, 1998). Such risks are transferred to other entities better willing and better suited to accommodate them without making any transactions on the primary asset or commodity. Generally, investors need an assured operating environment, which assurance derivatives provide. For avoidance of doubt, making a loss on a derivative instrument does not disparage its rationale for existence, since more than any other consideration it is supposed to introduce certainty. If its primary reason is to introduce certainty, then it naturally follows that in conditions of relative certainty, the instruments are bound to fail.

An investigation into the success factors of the Asian derivative markets revealed that volatility of the spot market, same as its size and liquidity played a critical role in its success (Sittisawad Sukcharoensin, 2018).We can draw parallels of the above from insurance, in the sense that consumers of insurance purchase insurance because they are weary of particular risks. The primary motive for which one is prepared to pay a premium is need for certainty. Any other consideration arising from that transaction such as an insurance company making profits is subsidiary. Further, in the absence of uncertainty, the insurance business model collapses, as there is no impetus to seek cover.

Having established that volatility is necessary, the ensuing question is what effect derivatives have on that volatility. There is not enough consensus going by existing literature, but generally, it has been hypothesized to increase, decrease or have no effect, depending on the dominant users of the market (Jeanneau Micu, 2003). For starters, any uncertainty should lead to an increase in the number of speculators and hedgers, as risk averse people will feel the impetus to transfer their risks. Risk takers on the other hand angle themselves to benefit from the consequent information differential or lack of it. The effect of volatility may also be differently examined by looking at the time intervals within which variable data is recorded. Some analysis consider intraday data while others considers weekly, monthly or quarterly data, all of which have different implications for the nature of volatility information at the point of analysis. Generally, this is a highly empirical question and a few examples are cited in the proceeding section below.

2.2 Derivatives Trading and Economic Growth

Derivatives represent the highest form of financial sophistication. In the past, a lot of literature surrounding it has mainly focussed on the pricing aspect as well as the information content of the products, risk management and regulation (Baluch Ariff, 2007). There is a clear scarcity of literature that details the economic functions of derivative markets. In the early 1990s when the pace for derivatives was picking worldwide, Merton (1992) in Baluch (2007) made a broad narration of derivatives and their important interplay with the economy. He argued that derivatives were the force behind globalisation of finance and would have an effect of enhancing greater economic growth and efficiency. He further alleged that this would happen through increased opportunities to share risk, lower transaction costs and reduce the moral hazards of asymmetric information. Generally, when taken within the ambit of financial development, derivatives can be analysed within the theoretical frameworks discussed in the preceding section.

Rodrigues et al (2012) conducted a useful study at a time when the use of derivatives was highly demonized and was singled out as one of the major accelerators of the 2007 financial crisis. At the time, a lot of ongoing social and political debates were centred on derivatives and ill branded them as dubious "weapons of mass destruction" (Jacque, 2010). The study covering 45 countries and spanning a period of 39 years, sought to establish the effects of derivatives on economic growth and its volatility. Consequently, it established a positive relationship between derivatives and growth as well as a stabilization effect on the same. The authors argued that derivatives have a behavioural effect in that they influence the users in these markets to channel their resources to growth sectors. Although the study does not actively investigate the issue of causality, the authors allude to it by giving the example of the London Metals Exchange which was established to cater for the risks associated with commodities between the purchase and delivery periods. Consequently, they assert that the main causation of a derivative market is the risk that enterprises face, which in essence is a demand following phenomenon. From this, we can deduce that causation flows from the real sector to derivative market.

Bujari et al (2016) examined the derivatives growth relationship among six of the world's largest economies, i.e. United States, European Union, China, Japan, India and Brazil for the period between 2002-2014. Using GMM method, they estimated a dynamic panel data model for the effect of derivatives on economic development by comparing the volume of transactions

over time and the effect it had on per capita GDP for all the countries. The authors conclude that derivative markets positively affect economic growth and enlisted measures to further make them robust. Like any other cross-country studies previously done, it is difficult to establish a standard convention of recording data across financial markets and to address country specific macro and micro factors from the study. Further, the authors do not mention how they handled disparities in contract sizes. For example, in emerging markets such as China, Brazil and India, the contract sizes tend to be smaller and this may give an inflated figure of the volume. Nonetheless, the study gives a very good global view of the relationship between volume of derivative trades and per capita GDP.

Srivasta (2010), examines the effect of derivatives in the economy through the banking industry in India. This paper acknowledges the important role of banks in mobilising savings in the economy and channelling them to deserving sectors but goes on to highlight the changing perspectives on revenue sources for banks (Srivastava Srivastava, 2010). Accepting risks is now considered a normal part of a bank's operations and it can be exploited to yield profits and realise value for shareholders. With this exposure to risk, banks need to shield themselves against any potential adversity linked with the risk. Therefore, the emergence of derivatives serves to augment the role of banks in discharging their key responsibilities in the economy. The study found active derivative usage in banks without a deep asset cover and bears some semblance with the conclusion by India Stock exchange, that derivatives are necessary for modernising banks (Srivastava Srivastava, 2010).

Unlike the results above Juraj (2014), establishes a negative relationship between derivatives and selected variables of the real economy. His study made use of correlation analysis and granger causality for time series data in high income countries spanning the period between 1986-2012. According to this study, the growth of OTC derivatives measured in outstanding notional amounts reduces economic growth in high income countries (Lazový Sipko, 2014). In addition, both the OTC and exchange traded instruments increases unemployment. In so far as causality is concerned, this study suggests that activity in the financial markets causes changes in the economy implying a supply leading causation relationship. However, the author does not expound on the transmission mechanism and how finance causes a negative relationship.

Just as there are mixed findings in the developed economies, there are equally conflicting results in developing economies. For example, Chellasamy (2016) finds very little effect of derivatives on real growth in India, contrary to the findings of Bujari (2010). That

notwithstanding, derivatives can help countries address the vulnerabilities they are exposed to, without governments having to intervene in the underlying markets and incurring huge avoidable expenditure. An obvious caveat to this statement is the fact that economic growth is very dependent on the size and depth of the financial system (Kirkpatrick et al., 2000). The efficiency of the market for the underlying is a much-needed prerequisite for any derivative instruments and markets to thrive.

Empirical evidence of derivative effect on volatility is largely inconsistent. However, a general trend is that in advanced economies, volatility increases whereas for most emerging economies, there is a decline or no effect in volatility. An examination of the effect of futures on volatility of FTSE -100 stock index reveals an increase in volatility in the spot market (Antoniou Holmes, 1995). However, contrary to previous interpretation, Antonio holds that this is due to an improvement in the quality of and speed of information circulating. The result represents market efficiency. In a subsequent publication, Antonio (1998) still looks at the effect of futures on stock volatility in selected countries. While he finds no change on the level of volatility, he concludes that the nature of volatility had changed, in the sense that futures reduce information asymmetries.

Singh et al (2016) conduct a similar investigation in India, this time investigating the effect of currency derivatives on the spot exchange rate and concludes that it has no effect. In all the above examples, it is evident that the nature of investigation is quite micro, in the sense that investigations are quite sectoral and involve high frequency time series data. Rodriguez (2012) departed from the sectoral analysis and investigated the effect of derivatives on the economy, involving 45 countries and concluded that there existed a strong volatility reducing effect. While there is not enough research using an economy wide approach to compare this investigation, Rodriguez result seems acceptable in the sense that, introducing economy wide stability is a desirable macroeconomic goal. This is an acceptable and less confusing result in judging whether or not derivatives are admirable.

From a regulatory view point, mishandling derivatives can result in massive losses and economy wide destabilisations. Over time, regulation has evolved with the market so as to clip its toxic effects, but it has not always succeeded. Credit derivatives immensely contributed to losses in the subprime mortgage lending period starting in 2007 and spiralling to a crisis in 2008 (Kennedy-Palmer, 2015). The innovation of securitisation and subsequent combination with derivatives created an unprecedented lethal weapon that poisoned financial soundness in

the US and the world in general. The main risk factor with the instruments then, was their opacity and the fact that they were widely held by many financial institutions, thus occasioning a highly potent systemic risk (Kennedy-Palmer, 2015).

As a prelude to the crisis, the Glass-Steagall regulation which effectively barred commercial banks from engaging in activities that were traditionally in the purview of investment banks mandate was repealed in 1999, thus removing such restrictions (Bugeja, 2012). In the absence of regulation, banks could create special purpose vehicles for which there was no accounting requirement. Knowing too well that they no longer had to hold the mortgage loans that they originated, there was rampant securitisation with little regard for default risk and shoddy credit due diligence. In some cases, asset sizes in the special purpose vehicles (SPV) grew more than the sponsor banks official book sizes, and when they were hit with defaults, the contagion effect triggered a crisis (Kennedy-Palmer, 2015). The abuse of SPVs was rampant, to the extent that some institutions with perverted morality, transferred some losses from their mainstream activities to the SPVs. Derivatives are useful instruments when tamed in a sound, comprehensive regulatory environment, but when they are left to develop a life of their own, detached from the realities of the real economy, they trigger disastrous effects.

CHAPTER THREE: DATA AND TEST METHODOLOGY

3.1 Data and Data Collection

For purposes of this study, a wide range of variables have been considered as shown in Appendix A. Generally, the study selectively borrows from the approaches of Baluch (2007), and Rodrigues(2012). Baluch interrogates the relationship between Derivatives and economic growth in emerging and developed markets and uses per capita income as a proxy for economic growth whereas the value of derivatives traded is proxied as the indicator for derivatives growth. Like Baluch, Rodrigues also examines the impact of derivatives trading, but focusses on GDP growth and its volatility. Both researchers in the above cases made use of cross-country data to make estimations.

This study narrows down to a country experience as opposed to a cross country analysis i.e. South Africa as was done by Bekale(2015), following the approach of Rodriguez. There have been slight adjustments in the specification, especially in the use of proxies for both derivatives' development and economic growth as well as the frequency of some of the observations. The study uses annual per capita income data as proxies for economic development as used in the case of Rodrigues and Baluch. However, for volatility estimation, more observations are needed and therefore, quarterly GDP series is used as a proxy for such estimation. This is because it is difficult to get a quarterly estimate of population data, to accurately compute quarterly per capita income. The use of quarterly and annual statistics is important because it avoids the noise factor inherent in time series data of higher frequencies such as daily or monthly data. It also helps in easing the data collection as some of it is recorded in limited data periods (annual, semi-annual and quarterly).

The choice of 'per capita' as the dependent is considered more useful than GDP because it is indicative of country productivity and its growth over time. In the South African case and most other emerging markets, production is still labour intensive and it's, therefore, prudent that the choice of considered variables emphasise on population in the metrics for economic growth. Progress in derivatives market has been represented by the value of derivative contracts traded; this value being a summation of equity and commodity contracts. The approach is a departure from the work of Bekale (2015) and Rodriguez (2012), who use volume of contracts as a proxy for derivatives development. Volume might be misleading because the size of contracts all over

the world is not standardized. In frontier and emerging markets, there is a general tendency to have smaller sized contracts, which artificially grow volume sizes, holding the budget constant. Growth in market activity can be traced more accurately using transactions value. This was the approach of Baluch (2007), who used the value of transactions as a ratio of GDP. Multiple sources are used to collect data for this study. Most notable, is the Reserve Bank of South Africa (SARB) and the International Monetary Fund's (IMF) online database.

3.2 Sampling

This research covers a study period between 1970 and 2017 to capture the differences before and after the commencement of derivatives trading. Adelegan (2009) reports that Johannesburg stock exchange adopted the trade of equity derivatives in 1990, and the trade of commodity derivatives in 1995 subsequent to the deregulation of the agricultural market. Bearing in mind that on-exchange derivative trading started in 1990, we consider data from 1991 as documented in the online database of SARB. It should be noted that for the first five years of data capture i.e. 1991-1995, the value considered is exclusively linked to equity derivatives, and it is only after 1996 that the values of commodity derivatives are included. As previously alluded, estimation of volatility needs more observations to tell than can be observed from annual data. For that matter, we estimate it with quarterly GDP observations from 1970-2017. Some tests are run using dummy variables to conveniently decompose pre and post derivative trades effects. These tests make use of the entire data set from 1970-2017, but the specific relationship between the value of derivatives trades and economic growth has been emphasized with derivatives data that exclusively runs between the periods of 1991-2017.

3.3 Relationship Models

Effects of trading in derivatives will be assessed by testing the robustness of the correlation between derivative market indicators with the indicators of economic growth. The relationship models are threefold, with the first being a regression analysis testing the effect on per capita, then a bivariate cointegration and causality analysis and eventually a volatility effect measurement. For the three relationships highlighted above, GMM, granger causality and

GARCH estimation will be used respectively. The proceeding sections detail why each method was considered, as well as the merits and demerits of each.

3.3.1 GMM (Generalised Method of Moments) Estimation

South Africa began trading on exchange derivatives in 1990, although the practice had started unofficially in 1987 (Adelegan 2009). As far as derivatives trading is concerned, this analysis seeks to establish the effect of trading derivatives on the economy as proxied by per capita income. From an empirical stand point, the effect can be isolated by running a regression of per capita income with a regressor of the variable being tested, which in this case is the presence of a derivatives market. Given that the data in the study covers two distinct periods before and after the introduction of derivatives, we represent derivatives trading with a variable that takes a value of zero in the pre-derivatives period and a ratio of value of traded derivatives to nominal per capita in the post derivatives period. This is unlike other approaches, where researchers use a dummy variable of 1 or zero. This study appreciates, that there were many reforms in the early 1990s, and therefore, the level of development in the first 10 years cannot be equaly compared to the last 10 years. Hence, we use a ratio which accommodates progressive development over the years. For example, Trade openness is an important consideration to factor out effects of global integration in the economy.

Bekale (2015) downplays the role of trade openness in South Africa, especially owing to the unique apartheid history of South Africa. He erroneously assumes that because South Africa had troubled trade relations with the global community, with subsequent sanctions ensuing from the same, then international trade must have had negligible contribution in the development of the country. The rebuttal proffered in this study is that failure to introduce a subtle control for it might discount valuable contribution of trade integration in the post-apartheid period. Moreover, if international trade was strained in the apartheid period, it is safe to assume that growth was equally suppressed, and the trade burst that came post-apartheid should have triggered a proportionate boom in the economy. Like in any typical empirical investigation, there is a natural need to identify any other regressors that might influence the endogenous variable to avoid misleading estimates. Baluch (2007) observes that there has not been any consensus in the choice of control variables when assessing the relationship between economic growth and financial development. While this is true, this research follows the

control variable presumptions of Bekale (2015) with some slight modifications. The considered control variables are inflation, credit to the private sector, expenditure and broad money supply m3.

Broad money (M3), inflation and gross expenditure capture the macroeconomic environment and its effect on growth. Broad money shows the facilitative function of intermediaries and their role in growth. Inflation tempers growth in prices whereas expenditure isolates consumer effects on the level of per capita . Finally, credit to the private sector controls for domestic and foreign investments in South Africa. Being a commodity economy, whose natural resources are exploited heavily by multinational corporations for export, there is a high likelihood that investments play a key role in the economy.

A final control variable employed by Rodriguez and applied in this research is the lagged variable of the dependent variable. He contends that lagged values of output possibly influence its current levels (Rodriguez 2012). At first instinct, this seems accurate and intuitively correct, but there is a huge amount of literature that challenges that position. Achen (2000) theorized that lagged dependent variables can potentially suppress the explanatory power of all or some of the exogenous variables. He further argues that a lagged variable has the effect of artificially improving the fit of a model thus tempering the real effects of other variables. While his concerns are valid, lagged variables are often preferred when capturing dynamic effects of a process (Keele Kelly, 2006). Economic time series data, as proxied by per capita income needs to be estimated in a dynamic context, hence the reason to follow the model of Rodriguez in allowing a lagged variable of per capita as a control variable. Having noted the above, it will be remembered that the list of control variables cannot be exhaustive. Subsequently the relationship model is presented as follows:

$$lnPCPT_t = \alpha ln\, PCPT_{t-1} + \gamma DERDUM_t + \beta Z_t + U_t \quad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where **PCPT** is per capita GDP, **Derdum** is the ratio of derivatives traded to per capita GDP and takes zero in periods before derivatives trading and the ratio after its introduction. **Z** represents control variables: **Broad money (M3), Inflation (INFLCPI), Expenditure and private credit (PVTCRDT)**. All the above control variables will be taken as level variables and subsequently log transformed for ease of manipulation and results interpretation. $\mathbf{U_t}$

represents the error term. The focus of equation 1 will be to get the coefficient $\boldsymbol{\gamma}$ of the dummy variable . $\boldsymbol{\alpha}$ **and** $\boldsymbol{\beta}$ will also be estimated but this is a subsidiary objective.

Equation 1 will be estimated using GMM, due to the known shortcomings of Ordinary Least Squares method (OLS). OLS functions best when the assumptions of Classical Linear Regression Model (CLRM) hold in entirety. One of such assumptions is the exogeneity of regressors, which implies that the explanatory variables should be uncorrelated with the error term. Modelling an equation with a lagged value of the dependent variable as a regressor has a high likelihood of introducing endogeneity in the model (Keele Kelly, 2006). This violation introduces heteroskedasticity and invalidates the use of OLS. In such a case OLS estimates are no longer BLUE (Best Linear Unbiased Estimates). They yield biased and inconsistent parameters.

A possible remedy for endogeneity is introducing a variable, called the instrumental variable (IV), which decomposes the explanatory power of an exogenous variable into its component effects with the dependent and the error term, the only requirement being that the variable is orthogonal (uncorrelated) with the errors and varies with the explanatory variable. While this method may produce consistent results, it is difficult to find strong instruments, and quite often the inference is wrong due to misleading standard errors. Further, the fact that the model must be exactly identified when using IV leaves little latitude for errors. To clip this challenge, the model can be overidentified by having more than one instrument and estimated in two stages, in what is the method of two stage least squares (2SLS). However, 2SLS method's main weakness is that it holds true asymptotically and should be used with caution when using small samples. It is also limited in the sense that it is used with homoscedastic endogeneity.

GMM is seen as a generalisation of both IV and 2SLS. It is an improvement over their respective weaknesses. When exactly identified, it mimics the properties of IV and has the benefit of providing efficient estimation in heteroskedastic conditions. It not only solves for variances of unknown forms, but depending on the weighting matrix used, it can also solve for autocorrelation (Andrews, 1991). This study uses the heteroscedasticity and autocorrelation consistent (HAC) covariance matrix as the weighting matrix. Seeing as GMM is a generalisation of 2SLSand IV, it follows then that the choice of instruments determines how well estimation is made. In a simplified time series analysis context, it is deemed plausible to use lagged values of regressors as instruments (Saikkonen Lanne, 2009). This study follows

this approach and uses the lagged values of the explanatory variables as instruments in the GMM estimation.

GMM, like many time series estimation techniques depicts accurate results when the variables being tested are stationary. Often, use of nonstationary data may lead to erroneous conclusions showing certain variables as significant when in fact they are not. As such, as a first step, the data will be tested for stationarity using the augmented dickey fuller (ADF) test. Where data is not stationary, it will be differenced accordingly.

3.3.2 Granger Causality

This section investigates the direction of causality between derivatives and economic growth. Causality is firmly anchored on the fact that past values of a variable **Y** may or may not have predicting power on another variable **X**. It is possible to prove the existence of a relationship from running a regression equation, but this does not automatically imply causality in statistics. To ascribe causality, we appeal to theoretical considerations and proceed to make empirical investigation. Unlike Bekale (2015) who uses the volume of derivatives transactions as a metric for derivatives trade, this study makes use of the value of derivatives trades for good reasons. In developing countries, there is a deliberate attempt to induce liquidity by having smaller sized contracts, which send false impressions of high volumes. To capture a better causal relationship, this study focusses on the budget of the traders as a constraint in market participation by considering the value as opposed to volume. Data used runs from 1991, shortly after the formation of the derivatives exchange in 1990. As previously mentioned, all data to 1995 is exclusively equity derivatives, but post 1995 it is both equity and commodity contracts.

A causality test is predicated upon cointegration of variables i.e. a test to establish the long run relationship of the variables. While there are many methods of testing for cointegration, several factors will be taken into consideration before deciding on the most appropriate method. They include: the order of integration for individual variables, the number of variables, their relationship etc (Hubana, 2013). For example, Engel and Granger proposed a bivariate cointegration procedure, contingent on the variables being integrated of order 1 (Posedel, 2005). On the other hand, should the model be multivariate, the Johansen approach is preferred (Dwyer, 2015). The other important consideration is the relationship existing between the variables. In cases of endogeneity, we use a vector autoregressive (VAR) model, whereas in

cases where both endogeneity and exogeneity are present, then the Autoregressive distributed lagged (ARDL) model performs much better (Bhaskara Rao, 2007). This study assumes a bivariate relationship between per capita income and derivatives value. To capture model dynamic effects, the lagged values of the dependent and explanatory variables will be used. Consequently, this introduces endogeneity, leading to the conclusion that ARDL is the method of choice. Furthermore, ARDL is more efficient when you have a small sample size and can give unbiased long run estimates. To confirm this position, an augmented dickey fuller test is conducted to prove that each of the variables is either I (0) or I (1).

3.3.2.1 Estimating ARDL Model

The generalised ARDL (p, q) model is specified as follows:

$$\boldsymbol{lnpercapita_t = \alpha_o + \sum_{i=1}^{p} \alpha_1 lnpercapita_{t-1} + \sum_{i=1}^{q} \alpha_2 lndervalue_{t-1} + U_t \ldots..2}$$

Where **p** and **q** are lag lengths associated with the dependent and independent variables respectively. $\mathbf{U_t}$ is the error term. It should be noted that the optimal lags, **p** and **q** need not be the same as is the case with a VAR model. The specification of this model occurs in two stages, with the first stage being a test of cointegration through the ARDL bounds test specified as follows:

$$\boldsymbol{\Delta lnpercapita_t = \alpha_o + \sum_{i=1}^{n} \alpha_1 \Delta lnpercapita_{t-1} + \sum_{i=1}^{n} \alpha_2 \Delta dervalue_{t-1} + \alpha_3 lnpercapita_{t-1} + \alpha_4 dervalue_{t-1} + U_t \ldots\ldots\ldots\ldots 3}$$

$$\boldsymbol{\Delta lndervalue_t = \beta_o + \sum_{i=1}^{n} \beta_1 \Delta Dervalue_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta lnpercapita_{t-1} + \beta_3 Dervalue_{t-1} + \beta_4 lnpercapita_{t-1} + U_t \ldots\ldots\ldots 4}$$

The symbol Δ is the first difference operator.

In order to obtain the optimal lag lengths of the variables, the test runs an unrestricted VAR model on the data in their transformed form as outlined above using the Akaike Information Criterion (AIC). This regression output is then used in the second stage in an examination of

the bounds F-test to confirm the presence or absence of cointegration. If the F statistic is greater than I (1) bound, then there exists cointegration and the converse is true for the 1(0) bounds. The process outlined above must be executed in both cases when each of the variables is the dependent variable.

Having full knowledge about cointegration, it is then possible to fully estimate a long/short run relationship, from which some inference about causality can be made. In the absence of cointegration, a short run ARDL (p, q) model will be estimated as follows.

$$\Delta y_t = \alpha_o + \sum_{i=1}^{p} \alpha_1 \Delta y_{t-1} + \sum_{i=1}^{q} \alpha_2 \Delta x_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5$$

Where y_t, x_t represent the dependent and independent variables respectively and e_t the model error term. If cointegration is proved, then a long run model will be estimated after which the errors from that model are extracted and re-estimated together with the short run model in an error corrected comprehensive model. The long run form is as follows:

$$y_t = \alpha_o + \sum_{i=1}^{p} \alpha_1 y_{t-1} + \sum_{i=1}^{q} \alpha_2 x_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

The residuals are then extracted and re-estimated in an Error Correction Model (ECM) as follows. X and Y are as defined above.

$$\Delta y_t = \alpha_o + \sum_{i=1}^{p} \alpha_1 \Delta y_{t-1} + \sum_{i=1}^{q} \alpha_2 \Delta x_{t-1} + \gamma ECM_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 7$$

Short run causal effects will be represented by the t statistic on the explanatory variables (short run coefficients). These interpretations are simply the ceteris paribus effects and inference will be based on the usual OLS standard errors and test statistics. In the case of a long run relationship, the t statistic on the lagged error-correction term coefficient indicates the presence of granger causality. The parameter γ indicates the speed of adjustment.

Table 7 below summarises the steps to be followed running the unrestricted regression, before arriving at the optimal model,

Table 7: Regression Output

Dependent Variable	F-Statistic	Cointegration	Model
Lnpercapita	Compared against I(0) and I(1) Bounds	Decision	ARDL/ECM
DerValue	Compared against I(0) and I(1) Bounds	Decision	ARDL/ECM

To confirm the above results about causality, a pair wise granger causality is also run to show the direction of causality in a more simplistic way.

3.3.3 GARCH (1,1) Volatility Estimation

This section aims to establish the effect of derivatives trading on economic growth volatility. Quite often, time series data follows a stochastic process that is characterised by varying levels of volatility, and this forms one of the key justifications for a derivatives market. More specifically, the question to answer is whether derivatives increase, decrease or have a null effect on volatility. As previously mentioned, volatility effects are better observed with data of a higher frequency than annual observations. As such, quarterly GDP data, which is readily available from 1970 to 2017 is used to show the effects of derivatives trading on growth volatility. In financial data, the square of volatility on day n; formally called the variance rate, can be estimated from the log return process of any series as follows:

$$\boldsymbol{\delta^2}_{\boldsymbol{n}} = \frac{\mathbf{1}}{\boldsymbol{m-1}} \sum_{\boldsymbol{i=1}}^{\boldsymbol{m}} (\boldsymbol{u_{n-i}} - \bar{\boldsymbol{u}})^{\mathbf{2}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\boldsymbol{8}$$

Where **m** is the number of the most recent observations, **u** is log return and $\bar{\mathbf{u}}$ is the average log return for the period. The returns series is rightly used to model volatility because of its stationarity property. It is a first difference of logged variables, hence it's integrated of order one. In this research, using GDP as a variable of interest, the return series gives economic growth (first difference of GDP series), hence it is an estimation of volatility in economic growth. Equation 8 shows clearly that volatility today is dependent on previous volatilities but fails to isolate their impact in the specific periods when such volatility was incident. There is thus an assumption of homoskedasticity which goes against heuristics in this case. Clearly,

some periods might have had more intense disturbances than others and its erroneous to assume that their contribution to today's volatility is equal for all of them.

A survey conducted on US stocks revealed three major stylized facts of financial data as follows: presence of serial dependencies, changing volatilities over time and heavy tailed distribution of data (Cont, 2007). Seeing the above practical issues with volatility estimation, Robert Engle introduced the now famous autoregressive conditional heteroskedasticity (ARCH) model, which mimics the stylized facts to a large extent. The distinctive feature of the model is that it recognizes that correlations and volatility are not constant over time and appreciates the serial correlation that exists over time. The ARCH model assumes different weights for each of the previous disturbances and assigns a weight α to each on condition that the sum of the weights is unity (Wong, 2014). Further, it is also assumed that there is a long run mean variance rate that should be given some weight as follows:

$$\delta^2{}_n = \gamma V_L + \sum_{i=1}^{m} \alpha_i u^2{}_{n-i} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 9$$

Where $\gamma \mathbf{V_L}$ is the long run variance rate, and γ is its weight. Still in this case, the weights must sum up to unity. Bollerslev improved on the above ARCH equation, by allowing the variance rate to have an extra autoregressive structure within itself to form what is now the Generalised Autoregressive Conditional Heteroskedasticity(GARCH) Model (Williams, 2011). The model assumes that a variance change is a function of the realizations of preceding errors and the changes represent random and temporary departures from unconditional, constant variance (Mallikarjunappa Afsal, 2008). In its general form a **GARCH (p, q)** is specified as follows

$$\delta^2{}_n = \gamma V_L + \sum_{i=1}^{p} \alpha u^2{}_{n-i} + \sum_{i=1}^{q} \beta \delta^2{}_{n-i} \ldots\ldots\ldots\ldots\ldots\ldots 10$$

Where **p** and **q** are the respective lags of the error term and variance respectively. The most widely used form of GARCH models is the parsimoniously specified GARCH (1,1) method as follows:

$$\delta^2{}_n = \omega + \alpha u^2_{t-1} + \beta \delta^2_{t-1} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 11$$

Where $\omega = \gamma \mathbf{V_L}$. The weights γ, $\alpha_\mathbf{i}$ and β should add up to unity and should be nonnegative to avoid having a negative volatility (Hull Basu, 2016). The variance equation, however, is always estimated as a subsequent equation after the estimation of the mean equation as follows:

$$y_t = \rho + \theta y_{t-1} + u_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 12$$

The GARCH (1, 1) model considered thus far can be extended to a multivariate case to include other variables. In the context of this study, a dummy variable that takes a value of zero in the pre-derivatives era and 1 post-derivatives will be included in the multivariate equation. The sign on the dummy variable is indicative of the direction of volatility i.e. if positive, it indicates a rise or a fall in volatility when it's negative (Gahlot et al., 2010). The multivariate case is as follows:

$$\delta^2{}_n = \omega + \alpha u_{t-1}^2 + \beta \delta_{t-1}^2 + \mu der\_dummy \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 13$$

The process of estimation will progress in the manner listed below

a. Subject the quarterly economic growth time series to a stationarity check through the augmented dickey fuller technique
b. Testing for Arch effects on the series to know whether the Arch group of models should be employed. If the series has some sort of clustering, then the Arch models will be employed.
c. Estimation of volatility in the multivariate regression. Through this equation, we can tell the effects of derivatives by looking at the sign and significance of the coefficient on the dummy variable.
d. Model Diagnostics

.CHAPTER FOUR: ANALYSIS OF RESULTS AND DISCUSSION

4.1 Comparison of Sample Means and GMM

This section shows the results of GMM as specified in the previous chapter but also checks to see how those results compare with a descriptive analysis of the sample means of per capita in both periods.

Table 8: Comparison of Per Capita Sample Means

	Pre-Exchange Period	Post Exchange Period
Mean	10.76167	10.79787
Median	10.76058	10.77069
Maximum	10.83595	10.94288
Minimum	10.71150	10.65457
STD Deviation	0.030945	0.109329
Skewness	0.639529	0.117093
Kurtosis	3.0009857	1.306746
Number of Observations	21	27

From the descriptive statistics table above, it is observed that per capita mean increased in the post derivatives period. Whether this increment is significant or not is important in contextualising the results of GMM. Should the test for the difference in means show that the increment is significant, then GMM will show or fail to show the proportion of growth accounted for by derivatives. However, if the sample means are equal, it is an early indication of the ineffectiveness of derivatives in driving per capita.

The means are compared using a t test and the hypothesis statement is a null presuming equal means and an alternative presuming that the mean in the period after introducing derivatives is greater than the mean in the pre-derivatives period as shown below:

$$\text{Ho}: \mu_1 = \mu_2$$

$$\text{H1}: \mu_1 < \mu_2$$

The t test results are as shown below:

Test for Equality of Means Between Series

Date: 11/21/18 Time: 20:01

Sample: 1 27

Included observations: 27

Method	df	Value	Probability
t-test	46	-1.469267	0.1486
Satterthwaite-Welch t-test*	31.20185	-1.638387	0.1114
Anova F-test	(1, 46)	2.158746	0.1486
Welch F-test*	(1, 31.2018)	2.684313	0.1114

*Test allows for unequal cell variances

All the tests and especially the t test have a p value > 0.05. We fail to reject the null and conclude that there is no significant difference in the means. Though very preliminary, this test indicates that derivatives trading has no effect on per capita.

4.1.1 GMM

Initially, the variables are transformed by introducing natural logarithms for ease of interpretation, after which they are checked for unit roots using the Augmented Dickey Fuller test. The unit root test outcome is reported in the table below:

Table 9: ADF Unit Root Test

ADF Unit Root Tests: Level :I(0)			
Variable	**t statistic**	**Probability**	**Conclusion**
Derdum	0.163472	0.9666	Non-Stationary
Pcpt	-0.7474	0.8242	Non-Stationary
Pvtcrdt	-2.4149	0.1433	Non-Stationary
M3	-2.3351	0.1658	Non-Stationary
Inflcpi	-3.3341	0.0732	Stationary
ADF Unit Root Tests:First Difference:I(1)			
Variable	**t statistic**	**Probability**	**Conclusion**
Der_dummy	-6.7823	0.000	stationary
Derdum	-6.7718	<0.01	stationary
Pcpt	-4.600	0.0005	stationary
Pvtcrdt	-3.6659	0.0080	stationary
M3	-3.8474	0.0049	stationary

Only inflation is found to be stationary at level, with the other variables being differenced to achieve integration of order 1. As such, new series for the transformed series were generated and were used in the main GMM estimation in place of their nonstationary equivalents.The summary of results from GMM estimation is provided in the table below and a detailed regression output is provided in Appendix 2.

Table 10: GMM Regression Output

Dependent Variable LNPCPT		
variable	**Coefficient**	**P Value**
LNPCPT(-2)	-0.021615	0.0002
D(LNDERDUM)	+0.006683	0.1561
INFLCPI	-0.003852	0.0022***
D(LNPVTCREDT)	+0.002718	0.9697
D_LNEXPENDITURE	0.637931	0.0002*
D_LNM3	0.003307	0.6318
R squared	0.830678	
Adjusted R squared	0.788347	
Durbin Watson Stat	2.4	
J statistic	1.75	
Pro(J Statistic)	0.1849	

The natural log of per capita is regressed against its lagged variables as well as other repressors as control variables. The lags of the regressors serve as instruments in estimation with GMM. A Durbin Watson Statistic of 2.4 is < 2 therefore implying that the data has mild negative autocorrelation. Further, a test for serial conducted and presented in appendix B1 shows that the data suffers from serial correlation. While these tests are important and necessary as routine robustness and model diagnostic checks, together with tests for multi collinearity and heteroscedasticity, they are rather inconsequential in the case of GMM. To emphasize this point, it should be remembered that the Standard errors and covariance are computed using Heteroskedastic and autocorrelation consistent estimation weighting matrix, which addresses concerns of autocorrelation, multicollinearity, and heteroscedasticity. A more relevant diagnostic check to conduct is the orthogonality of instruments with the error term. Individual tests conducted in E-views show that each instrument is orthogonal and unrelated to the error. This result is corroborated by the probability of the J statistic in the regression. The J statistic Probability, being > 0.10 is significant and shows the validity of the over identifying restrictions.

The regression shows an insignificant positive relationship between the natural log of per capita GDP and derivatives dummy. Lagged per capita and gross expenditure show positive and negative significant relationships with per capita GDP respectively. Inflation also shows a significant but negative relationship with per capita at the 1% level. Private credit and broad money indicate a positive insignificant relationship.

From the results above, it is evident that gross expenditure accounts for growth in per capita and leads to a generalisation that South Africa is in fact a consumer economy. On the other hand, private credit to the domestic market which remotely alludes to savings and investments in South Africa has a negligible contribution to per capita. More interestingly, the results also take away some lustre from the role of intermediaries in affecting per capita. Indeed, the sign on broad money (Intermediaries) is positive as expected but insignificant. The result that inflation has a significant negative effect in the economy is in tandem with theory and other empirical findings (Harris et al., 2001).

The result that derivatives have an insignificant effect on the economy agrees with the findings of Bekale (2015) but differs with those of Rodriguez (2012), who finds a positive and significant relationship. Baluch (2007) exemplified a mixed result finding, through his cross-country analysis which shows an insignificant relationship for most developing and developed economies, together with an extreme outcome of an isolated significant positive relationship in a developing economy and another isolated significant negative relationship in another developed economy.

4.2 Granger Causality

This test was conducted to establish the direction of causality between the natural log of per capita and the log transformed values of derivatives traded starting from 1991 to 2017. Granger causality is tested using two methods to countercheck the results. The first method is the pairwise granger causality test with results as shown below.

Pairwise Granger Causality Tests
Date: 09/30/19 Time: 01:06
Sample: 1991 2017
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
D(LNPCPT) does not Granger Cause D(LNDERVALUE)	24	0.22655	0.7994
D(LNDERVALUE) does not Granger Cause D(LNPCPT)		0.30446	0.7411

The simplistic test above shows that per capita and derivatives do not have a causal relationship between themselves. The null that per capita does not cause derivatives is accepted owing to the p value of 0.79 which is > than 0.05. Similarly, the null that derivatives do not granger cause per capita is accepted given that the P value of 0.74 exceeds the standard 0.05 threshold for rejection. Based on this test, there is no causality between the two variables.

In order to further substantiate the results above, a bivariate granger causality test was also set up using the ARDL model. The test begins with a check for stationarity to confirm that both variables i.e. natural log of per capita and the log of derivatives are either I (0) or I (1). The following table captures that result:

Table 11:Granger Causality ADF Test(Unit Root)

ADF Unit Root Tests: Level :I(0)			
Variable	**t statistic**	**Probability**	**Conclusion**
LnderValue	-2.400759	0.1520	Non-Stationary
LnPcpt	-1.052674	0.7178	Non-Stationary
ADF Unit Root Tests:First Difference:I(1)			
Variable	**t statistic**	**Probability**	**Conclusion**
Lndervalue	-3.696534	0.0110	Stationary
LnPcpt	-4.000100	0.0053	Stationary

So long as the variables are not beyond I(1), ARDL is valid and the variables need no transformation. They can be used in their log level forms. Before specifying the ARDL models, a cointegration test was run following the steps outlined in chapter three. Where only a short run relationship exists, an ARDL model is run, and where a long run relationship exists, an error correction model is run. The table below summarises the findings of cointegration.

Table 12: Results of Cointegration Test

Dependent Variable	**Exogenous Variable**	**Optimal Lag**	**Bounds Test**	**Decision**	**Model**
LNPCPT	LNDERVALUE	ARDL (1,1)	$F_{18.71469}$ >I(1)	Cointegration	Error Correction Model
LNDERVALUE	LNPCPT	ARDL (1,1)	$F_{25.61144}$ >I(1)	Cointegration	Error Correction Model

As a first step to the bounds test, an unconstrained regression was run to establish the optimum number of lags for the variables with each of them as the dependent variable. The first equation with LNPCPT as the dependent yielded an ARDL (1,1) model implying use of 1 lag for both the depended and independent variables. Using the unconstrained equation, a bounds test was run, the results of which are captured in the above table. The F statistic obtained in that regression was 18.714 and is > than I (1) at the 1%, 5% and 10% significance levels. The inference for this test is that when LNPCPT is the dependent variable, and LNDERVALUE the explanatory, there is cointegration/Long run relationship.

In the converse case, when derivatives is the dependent, the unconstrained regression gives an ARDL (1, 1) model which also confirms the presence of cointegration. The F statistic of 25.61144 in this case is > than the I (1) bound, thereby confirming the presence of a long run relationship. Based on cointegration results, an error correction model was estimated for both equations to show the short and long run effects on one another.

Tables 13 and 14 summarise the outcome of the error correction models for the two equations

Table 13: Error Correction Regression Equation 1

Dependent Variable: D(LNPCPT)		
Variable	**Coefficient**	**P Value**
C	0.006570	0.5653
D(LNPCPT(-1)	0.337958	0.0880
D(LNDERVALUE(-1)	0.015564	0.6629
ECM1(-1)	-0.368435	0.4456

Table 14: Error Correction Regression Equation 2

Dependent Variable: D(LNDERVALUE)		
Variable	**Coefficient**	**P Value**
C	-0.046192	0.6126
D(LNDERVALUE(-1)	0.985903	0.0013
D(LNPCPT(-1)	2.262506	0.4851
ECM2(-1)	-0.987355	0.0292

The equations above show combined output of short and long run effects, with the short run effects being captured by the differenced variables. The error correction variables in both cases are residual extracts from the long run relationship estimates of the cointegrated variables and represents the rate of convergence in the long run. Model stability diagnostics was done using the CUSUM tests and revealed that models were stable and within the prescribed 5% interval as can be seen in appendix C1 and C3 graphs. Further, serial correlation tests proved the absence of the same.

Both equations show a lack of granger causality in the short run, as evidenced by the insignificant coefficients of the counter variable in each equation. In table 1, the coefficient on derivatives assumes a p value of 0.669 which is insignificant at the 10%, 5% and 1% significance levels. On the other hand, table 2 shows that per capita has an insignificant explanatory power on derivatives, as represented by the p value of 0.4851, which follows a similar interpretation as the one above. The differentiating element of the tests is the error

correction term which is significant in equation 2 and insignificant in equation 1. Remembering that the p value of the ECM term indicates granger causality in the long run, it is concluded that per capita granger causes derivatives in the long run. The above findings are similar to the results of Marozva (2014), who also finds a unidirectional granger causality flowing from economic growth to derivatives. Baluch (2007) notes an independent relationship between derivatives and economic growth in developing economies, and a causation running from the economy to derivatives in developing economies.

4.3 GARCH (1, 1)

This test investigates the effect of derivatives on economic growth volatility estimated through a GARCH (1, 1) technique from 1970 to 2017. Appendix D1 shows the descriptive statistics of the series before and after derivatives. This early diagnostic does not have a huge significance on the bearing of the GARCH estimation but is useful in contextualising its findings. Through these statistics, normality of the series before and after introducing derivatives can also be seen. After derivatives, kurtosis improves marginally from 2.65 to 3.43, giving an indication of a gradual drift to a mesokurtic distribution. The left skewness also increases in the post derivatives period. Generally, based on the kurtosis and skewness results as well as the Probability of Jarque-bera statistic for normality, growth series is closer to normality in the pre-derivative period than after. Standard deviation reduces substantially, but a test for equality of variances shows that the difference is significant as can be seen from Appendix D2. This result is interpreted with a tinge of salt, remembering that an arch effect is predicated on a moving average and autoregressive component.

In terms of GARCH estimation, a pre and post derivatives dummy variable is introduced to check the effect on volatility. The test starts with a check for unit root in economic growth series. This series functions as the returns series and forms the subject for volatility investigation. The results of the ADF test indicate that the data is stationary at 1% significance. Subsequent to the unit root test, an arch test is conducted to establish whether the data justifies an Arch approach. The outcome of the ARCH effect test is show in the table below:

Table 15: Arch Effect Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.50E-05	1.24E-05	3.629609	0.0004
RESID^2(-1)	0.193507	0.071670	2.699983	0.0076
RESID^2(-2)	0.050857	0.073024	0.696445	0.4870
RESID^2(-3)	0.104693	0.071594	1.462305	0.1454

Notes: R squared 0.0647 Adjusted R squared 0.049 Observations 189 F=4.271 Significance F=0.006

The regression shows that the residuals of the AR (1) process are significant at the 1%, thus is indicative of an arch effect. Since the F statistic is < 0.005, we reject the null that the 4 coefficients are the same. This Arch conclusion can also be captured graphically as follows.

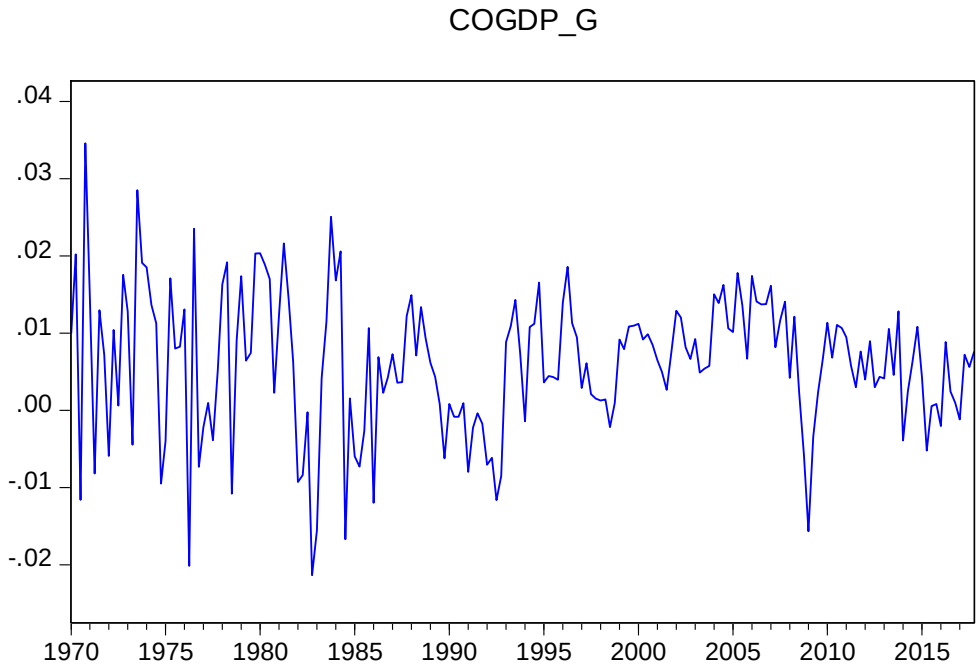

Figure 7: Constant Quarterly GDP Growth

Source: Author's Compilation

The graph indicates a high level of clustering, in that, periods of high volatility follow other periods of high volatility, and the converse is true for low volatility periods.

The outcome of the multivariate volatility estimation specified in equation 13 is as shown in the table below:

$$\delta^2{}_n = \omega + \alpha u_{t-1}^2 + \beta \delta_{t-1}^2 + \mu der\_dummy \ldots\ldots\ldots\ldots\ldots\ldots\ldots 13$$

Table 16: Multivariate Volatility Regression Results

Volatility Estimation		
Term	Coefficient	P Value
Constant	1.22E-05	0.2813
ARCH(1)	0.074684	0.1028
GARCH(1)	0.816987	0.0000
Dummy	-9.63E-06	0.3158

The results show the behaviour of economic growth volatility over time by revealing the ARCH and GARCH terms, as well as the effect of derivatives trading on that volatility. A significantly negative/positive coefficient on the dummy variable is indicative of a falling/rising effect of derivatives on volatility. The arch term, α indicates the influence of stochastic deviations in prior period error terms on volatility. GARCH term measures the portion of realized variances from the previous period that gets carried into the present period. A combination of the arch and Garch term i.e.($\alpha + \beta$) determines the dynamics of volatility in the short run. For example, if the ARCH term is large, it implies that volatility responds intensely to market movements whereas a large GARCH term indicates that disturbances take a while to dissipate. More precisely, when the sum is unity, the effect is permanent. If the sum is slightly less than unity, but closer to unity, the effects are assumed to be persistent and take a long time to fade. A lower ARCH and a higher GARCH, would give spiking volatility.

At this point, it shall also be remembered that the constant term, is a multiple of the weight γ and the long run variance $\mathbf{V_L}$. Because the constant is positive, it implies that the weight for the long run volatility and the volatility itself are positive. From the table above, the arch and Garch terms are in conformity with the non-negative assumption, with GARCH being significant. Their combined sum gives 0.89167, alluding to a high persistence of disturbances. However, the low arch term which just shies off the 10% significance mark means that

volatility in South Africa mirrors a spike pattern, where past market movements cause minimal but long lasting disturbances.

The coefficient on the dummy of derivatives is negative and insignificant at the 10% level and implies that trading derivatives has no effect on volatility. The results above give a dichotomous view of the nature of volatility in South Africa's economic growth series and the effect derivatives have had on the same. In conclusion, the country's growth volatility has a long memory, but is sticky in the sense that it's not very erratic, owing to the small and insignificant Arch term. On the other hand, derivatives have no effect on that volatility. These results agree with most research findings in developing economies (Kabir, 1997; Mallikarjunappa Afsal, 2008). However Bologna (2002) found a volatility reducing effect in the Italian stock market, whereas in the US market, derivatives have been found to have a volatility increasing effect (Antoniou Holmes, 1995).

4.4 Discussion

Rodriguez (2012) investigated the effects of derivatives on per capita in developing and developed nations, finding a positive and significant relationship between them; as well as a volatility decreasing effect. More recent research on this relationship, in six of the major world economies, indicates a positive relationship (Bujari et al., 2016). This study contradicts the above findings as the results of the GMM estimation show a negative and insignificant relationship. Further, the study proves that granger causality between the two variables is only long term and flows from the economy to derivatives. Finally, it has also been shown that the volatility in South Africa tends to be spiky, and derivatives have a null effect on it. In a nutshell, the market just survives, and no benefit or harm can be ascribed to it!

The causal relationship established supports the demand following hypothesis. It implies that economic development is precursory to introduction of derivatives. Sustained gains in the economy eventually lead to an environment where derivative instruments are desired. The instruments are borne out of a need and should not be a creation of financial creativity or be introduced for the sake of it or achieving some status as a market / economy. They should not have a life of their own, detached from the realities and progress of the real economy. This result partly explains the financial crisis of 2007/2008 which was a brazen exhibition of financial creativity through an over-generation of instruments that never addressed any real

problem but instead revolved primarily around profit incentives. Real development must precede derivative usage.

In the South African case, deregulation of agriculture in 1995 - which led to the dissolution of control boards and marketing boards - was one of the most fundamental developments leading up to the establishment of commodity derivatives. The result was a decentralization of agricultural price determination, plunging the country into a whole new universe, characterised by price and information risk, as well as unfair competition. Indeed, the previous system where the government could guarantee farmers' price to their corn was admirable to the extent that it eliminated uncertainty. On the downside, such guarantees occasioned a huge cost and distortion to the economy. Therefore, such conditions of uncertainty following deregulation created a highly fertile environment for the introduction of instruments and consequently, a successful commodity market was established in 1995. The move towards a floating exchange rate system is also a landmark development for the success of derivatives in South Africa.

Other than the role of government through policy, there is need for institutional preparation in the form of robust financial institutions; sophisticated systems capable of supporting complex transactions; financial reforms; adequate infrastructure; a strict regulatory and oversight environment etc. In a way, if derivatives usage can be considered as the epitome of financial finesse, then it should follow an ordered evolution process whose milestones should be marked through progressive economic development. The market should ask for these instruments when it has developed the muscle to use them efficiently, including an elaborate network of trading, settlement and other logistic systems.

The African Development Bank Group, in its *Guidebook on African Commodity and Derivatives Exchanges*, lists various failed attempts at creating commodity exchanges in selected African countries, citing poor approaches mooted in ivory towers, and completely unrelated to the realities on the ground (Mezui et al., 2013). The significance of economic development and its causal effect on derivative usage cannot be overemphasised. It is also important to note that the causation established in this study is long-term, therefore, short-term interventions may not generate sufficient impetus for the institutionalisation of derivatives.

Long-term granger causality established does not reveal the exact measurement of 'long'. Time could, therefore, be a limiting factor to the contributing power of the South African market. If this is true, then the difference made by time is market size. Derivatives are instruments of scale and often thrive in economies of scale. Baluch (2007) finds that liquid markets do better

than their illiquid counterparts; and bigger markets are found to be more liquid than the smaller markets. Therefore, it is hoped that with the passage of time, the South African market will get to an optimal size, capable of attracting sufficient liquidity to thrust it into economy-wide effectiveness.

An obvious advantage of JSE is the fact that it has a first mover advantage in the region and may experience an accelerated growth towards its optimal size. Prior to its first collapse, Hong Kong Futures Exchange had the advantage of being the first derivatives exchange in Asia and thus acquired a clear competitive edge over other regional late comers (Shamsher Taufiq, 2007). A first mover can consolidate a huge market to get to the optimal size quickly. In 2017, this trend was seen in South Africa when the JSE listed a dollar denominated Zambian maize contract (Cloete, 2017). Leveraging on the region will ensure that size grows quickly.

Another dimension of size, and a possible limiting factor of derivatives in South Africa is in the breadth and influence of product offering. For financial derivatives, South Africa has the highest number of product lines per exchange, surpassing other exchanges worldwide (Hassan, 2013a). However, these product lines have too low a capacity to elicit global influence and have negligible effect on the economy. It is worse in commodity derivatives where JSE has in the past introduced foreign referenced contracts which are then settled in foreign prices . In such a case, the process of price discovery is defeated and the fundamental precincts for the establishment of a derivatives market are violated. However, this situation seems unavoidable – a necessary evil - considering that between 2002 and 2009 there was no new listing on the commodity segment (SARB, 2014). JSE was then compelled to venture into foreign referenced commodities to raise activity . Increase in product line is therefore important, but more important should be the maturity of the product offering to serve their economic purpose especially in the context of derivatives.

This study finds derivatives to have a null effect on growth volatility. In developed economies, volatility has been shown to increase as information becomes actionable quickly (Antoniou Holmes, 1995). Intuitively, this makes sense from a micro perspective, such as volatility modelling of stocks. However, since this study considers volatility in quarterly series of economic growth, the expected sign for a stabilising effect at a macro level is negative. Nonetheless, we find that it is insignificant, thus rendering derivatives usage ineffective. The low arch term in the result seems to suggest that the market is shielded from disturbances such that a proper market reaction is inhibited. Such protection keeps volatility; the main recipe for

a functional derivatives market at bay. The precious contribution of derivatives to an economy is its creation of certainty, in the face of volatility. Stakeholders dealing in the instruments switch to them when there is uncertainty, otherwise in a certain and predictable environment, no one would need them. It is often presumed that higher market volatility begets more active trading in derivatives markets (Jeanneau Micu, 2003). Artificially shielding the market from volatility renders derivatives ineffective.

Exchange controls play an active role in shielding the South African economy from volatility. The country has a long history of funds outflow restrictions dating back to 1939 (Stals, 1998). These controls persisted during the tumultuous period of apartheid and were only revisited post-independence in 1994, following a realization that they were distortionary. However, the state was opposed to a 'big bang' approach of wiping them out in one swoop and only preferred a phased approach. To date, significant milestones have been achieved in this liberalisation process, but a lot still remains to be desired.

The reform process has yielded noticeable benefits in the financial sector, such as improved bond and stock markets, a better banking sector etc. This study, however, holds the view that the persistence of controls have delayed the effect of derivatives through muzzling volatility. At the beginning of the millennium, Malaysia had a similar experience when, despite having one of the exchanges with a head start in Asia, introduced capital controls and consequently diminished the volumes of derivatives (Bacha, 2004). Finally, it is postulated that derivatives in South Africa appear not to have any stabilising effect due to a structural mismatch between local risks/volatility and derivative market solutions arising from foreign markets. This means that if indeed commodity/financial markets have some volatility, but the prices to clear the market are foreign derived, as in taking prices from developed economies, then volatility will not be arrested.

4.5 Recommendations for Kenya

Plans to start a derivatives market in Kenya have been in the offing for a long time but gained sufficient momentum when the Capital Markets Authority (CMA) included it as part of a 10-year master plan to revamp the market running from 2014 to 2023. The latter part of 2018 was spent in a test pilot phase that is intended to pave way for the roll out and implementation of

the market. Having looked at the South African experience, we can abstract some lessons for Kenya.

One of the biggest learning points is market deregulation. It is remarkedly impressive how fast a commodity market was set up in South Africa after the deregulation of the agricultural sector, as well as the gains made on financial derivatives with each phase of financial liberalization. Deregulation will remove the volatility shield and create a demand for derivatives. Currently, the government is firmly at the heart of cereal pricing and production especially through the agriculture ministry and the National Cereals and Produce Board (NCPB). Farmers look up to government for fair prices. Further, there are tight regulations on import and export of maize. This involvement by government removes risk and is consequently defeating of any intention to sustain a commodity market. More than that, it occasions a huge cost to the economy. Farmers need to turn to contractual farming which is prescriptive of derivatives.

Deregulation should in fact be economy wide. Currently the government has imposed a cap on interest rates, which like the previous example, leaves very little room for volatility. As things stand, despite market swings, every player knows the wiggle band for interest rates. Such definiteness frustrates the motive of a derivative instrument. As a matter of fact, the cap on interest rates exacerbates the situation. In most economies, equity markets are larger than the bond markets, yet in Kenya, the bonds market is the bigger one. This is not to mean that it is very developed, but points to how small and illiquid the unidirectional equity market is.

Imposing an interest cap that estranges lenders from borrowers further augments the growth of the bonds market at the expense of economy wide development. Banks continue to invest in government securities as opposed to private sector. The domination of government bonds also introduces some sense of sceptism to corporate bond listings and eventually leads to a very illiquid secondary market, incapable of sustaining a derivatives market. One of the more commendable government deregulation efforts was the removal, through legislation, of the cap on foreign ownership of firms in a bid to stir up activity in the secondary equity market (CMA, 2016). But even so, the market remains quiet, with most investors preferring to buy and hold. This trend of deregulation should persist.

The size of a derivatives market also determines its success. Like South Africa, Kenya should have a regional approach in the establishment of a derivatives market. This scope is captured in the master plan and is captioned as an intention to be the regional gateway for Central and East Africa. One way of doing this is to leverage on the momentum of political economy

dynamics currently in play, to agitate for a first mover advantage in the region due to obvious advantages discussed in the previous section. Financial derivatives may face limited competition, but the commodity sector faces an imminent competition threat from Ethiopia and Rwanda who already run successful commodity exchanges with a potential to transition into efficient derivative markets.

The above point leads to the discussion on granger causality and the direction of causation from the economy to derivatives. It may seem ambitious of Kenya to have dreamt of commodity derivatives without even having a commodity market. The approach is very idealistic and may suffer the fate of other failed attempts. Suffice to mention that there is already a warehouse receipt system bill in place as well as advanced regulatory and operational framework in anticipation of commodity transactions. However, this alone is insufficient. A market-driven approach would neither have to worry about where or who will construct the warehouses for storing commodities, nor the logistics and infrstructure of delivery. Such considerations should evolve in a guided fashion in a free economy led by developments. If such market centric concerns are determined centrally by technocrats, the propensity to fail is high. While the die has already been cast, the government should engage in deep experimental and piloting procedures to accurately decipher information that will ensure success. Moreover, there should be enough involvement of the private sector to reduce the roll out costs.

Finally, efficient regulatory systems in South Africa have rapidly raised investor confidence in the country. In 2018, the market moved to a twin regulatory approach like most developed economies of the world, learning from the 2008 financial crisis. In Africa, Egypt has also made the transition. Kenya should aim to form their derivative market on the bedrock of sufficient oversight structures that can ensure investor confidence. Plans are underway to make the switch to a twin regulation system, but there is need for urgency.

Still on the demand following hypothesis, the risks described above notwithstanding, it appears that Kenya has clear advantages she can capitalise on. Among many sub-Saharan economies, the country stands out as one of the more mature economies with a development threshold that necessitates the use of derivatives, even though the decision to have a derivatives market seems to draw more impetus from the status it confers on the market than the function it plays in it. Consistent with theory, a lot of preparatory work has already been done. There have been extensive bond reforms; systems upgrade for the exchange and the settlement corporation; and introduction of securities lending and borrowing; among other innovations listed in the master

plan. The financial sector is relatively liberalized, seeing as there are no exchange controls and the recent few years have seen revision of laws to further entrench that liberalism. It also helps that Kenya is a fintech leader and can use her innovative prowess to tap into a wide asset class in terms of product offering and in improving the efficiency of the market. A good example was the launch of M-Akiba a retail government bond issued through mobile devices in 2017 (Ndung'u, 2018). There is every indication that the operating environment is good for a successful market. As a final thought, and at the risk of sounding paradoxical, it is not lost to observation that the pilot test phase for the much publicised high tech M-Akiba bond was very successful. However, the first actual bond issue through it was undersubscribed and grossly underperformed!After all is done and said, this study only finds a long run granger causality, and any intervention should be applied with 'long term' in mind.

CHAPTER FIVE: SUMMARY AND CONCLUSION

5.1 Summary

The study was carried out with the objective of establishing the effect of derivative trading on economic growth of South Africa, establishing the causality relationship between the two variables and the derivative effect on volatility of economic growth. For the three objectives, GMM, ECM and GARCH (1,1) techniques were used to estimate the relationships. Natural log of per-capita was used as the proxy for economic growth, whereas the log of value of derivatives traded was used as a proxy for derivatives . Data used ranges from 1970-2017 and was sourced from the Reserve Bank of South Africa and the International Monetary Fund website.

5.2 Conclusion

The study finds that derivatives market in South Africa is merely surviving, and no benefits or harm to the economy can be ascribed to it. Its relationship with per capita is insignificant and has a null effect on economic growth volatility. Among the possible explanations for its ineffectiveness is lack of volatility in the market due to shielding effects arising from capital controls, discovery of prices in foreign markets, small market size and the time factor. On granger causality, the study shows that economic development causes derivatives, and finds that it is in fact part of the reason that South Africa has a better derivatives market among Sub Saharan nations. Developments in regulation, actual infrastructure, banking and other sections of the economy have plunged them to a maturity necessitating a derivatives market.

5.3 Recommendation for Further Research

The above results are crucial, but only show a fraction of derivatives market. OTC derivatives are quite large, and it is important to interpret the result with caution given that there has not yet been an investigation of the effects of the OTC market yet. The biggest challenge with OTC

markets is that the dealings are mostly in the nature of private transactions and therefore getting data is difficult. However, in the wake of the financial crisis regulators are advocating for more transparency, even demanding that OTC transactions be disclosed. In South Africa, the piece of legislation making such a demand was passed in 2012. This makes it possible to analyse isolated effects of OTC markets, or even the combined effects of OTC and exchange markets.

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Appendix A1

YEARS	PCPT	DERVALUE	PRIVATE CREDIT	INFCPI	M3	TRADEOPENNESS	EXPENDITURE	DERDUM
	RANDS	R Millions	R Millions		R Millions	R Millions	R Millions	RANDS
1970	44869	0	6992	6,667	7923	6030,000	13059,000	0
1971	45647	0	7631	6,250	8609	6781,000	15046,000	0
1972	45288	0	8654	5,882	10074	7684,000	16018,000	0
1973	46233	0	10896	5,556	12113	9499,000	19008,000	0
1974	47934	0	12764	15,789	14241	13723,000	23689,000	0
1975	47653	0	14873	9,091	17099	15806,000	28802,000	0
1976	47625	0	16464	12,500	18685	17491,000	32150,000	0
1977	46458	0	17904	11,111	20535	19003,000	35248,000	0
1978	46710	0	20214	10,000	24352	22865,000	38898,000	0
1979	47373	0	23498	15,152	28168	28720,000	46025,000	0
1980	49377	0	29655	13,158	34655	39350,000	61504,000	0
1981	50815	0	38124	16,279	40827	42662,000	76609,000	0
1982	49465	0	44686	14,000	47056	43972,000	83586,000	0
1983	47456	0	53304	12,281	54779	43147,000	97012,000	0
1984	48768	0	65390	10,938	64626	54331,000	113258,000	0
1985	47126	0	75411	16,901	72553	68882,000	125227,000	0
1986	46112	0	82604	18,072	79315	78192,000	147259,000	0
1987	46082	0	94815	16,327	93285	88391,000	170109,000	0
1988	47021	0	121076	13,158	118750	108387,000	212131,000	0
1989	47144	0	145516	14,729	145271	121009,000	256648,000	0
1990	46020	0	168341	14,189	162652	124619,000	296943,000	0
1991	44610	23291	192672	15,385	182615	130227,000	340678,000	522103
1992	42754	49177	209487	13,846	197221	143848,000	377403,000	1150232
1993	42386	108038	229804	9,459	210994	171706,000	422621,000	2548908
1994	42849	211549	268926	9,053	244150	202309,000	494950,000	4937081
1995	43267	201889	316710	8,679	281156	245909,000	563893,000	4666120
1996	44193	278400	367213	7,292	330448	296156,000	633008,000	6299640
1997	44420	369983	419872	8,738	387631	329377,000	705474,000	8329199
1998	43720	502834	489893	6,845	439480	372425,000	765228,000	11501235
1999	43826	639442	532521	5,014	485419	391181,000	826575,000	14590471
2000	44735	838377	590063	5,305	520665	486768,000	926095,000	18740963
2001	45075	1089686	674047	5,793	606276	573304,000	1016497,000	24174953
2002	45798	1115509	703581	9,048	715817	727494,000	1166898,000	24357155
2003	46287	961618	838500	5,895	808047	681468,000	1282243,000	20775120
2004	47605	1201623	954224	1,443	914150	754230,000	1469103,000	25241529
2005	49335	1649483	1140195	3,455	1101130	871249,000	1635402,000	33434337
2006	51331	3160670	1434873	4,519	1349293	1108740,000	1842879,000	61574292
2007	53334	5108703	1743858	7,143	1667580	1343396,000	2115473,000	95786984
2008	54322	5217077	1981865	11,053	1915016	1726227,000	2412255,000	96039855
2009	52838	3389976	1979517	7,109	1949297	1389711,000	2509618,000	64157917
2010	53823	3873450	2087865	4,277	2084202	1538582,000	2713966,000	71966446
2011	54968	4722078	2216669	4,950	2256727	1817601,000	2997952,000	85905945
2012	55543	4835748	2439476	5,660	2373439	1981586,000	3292495,000	87063140
2013	56232	5551796	2589003	5,740	2512251	2274143,000	3621720,000	98730189
2014	56549	6472916	2808739	6,152	2693899	2451958,000	3853462,000	114465614
2015	56518	7396482	3094380	4,545	2975907	2495681,000	4096180,000	130869493
2016	56054	7900585	3252270	6,304	3156547	2644579,000	4332923,000	140945963
2017	56016	6742758	3470553	5,317	3359131	2702570,000	4601547,000	120372001

Appendix A2

Quarter yrs	constant GDP R Millions	Quarter yrs	constant GDP R Millions	Quarter yrs	constant GDP R Millions	Quarter yrs	constant GDP R Millions
1970	990426	1982	1491881	1994	1622832	2006	2439551
1970	1010636	1982	1479432	1994	1640437	2006	2474200
1970	998969	1982	1479054	1994	1658888	2006	2508372
1970	1034117	1982	1447786	1994	1686577	2006	2543057
1971	1049434	1983	1425440	1995	1692669	2007	2584351
1971	1040879	1983	1431359	1995	1700185	2007	2605530
1971	1054438	1983	1447859	1995	1707524	2007	2636065
1971	1062017	1983	1484583	1995	1714263	2007	2673414
1972	1055756	1984	1509773	1996	1738318	2008	2684648
1972	1066801	1984	1541138	1996	1770877	2008	2717424
1972	1067460	1984	1515594	1996	1790973	2008	2723918
1972	1086364	1984	1517937	1996	1807959	2008	2708410
1973	1100375	1985	1508894	1997	1813153	2009	2666281
1973	1095481	1985	1497922	1997	1824244	2009	2657131
1973	1127164	1985	1493968	1997	1828055	2009	2663293
1973	1148876	1985	1509943	1997	1830815	2009	2681051
1974	1170343	1986	1491954	1998	1833129	2010	2711577
1974	1186429	1986	1502255	1998	1835721	2010	2730077
1974	1199866	1986	1505635	1998	1831698	2010	2760428
1974	1188540	1986	1511957	1998	1833468	2010	2789950
1975	1183780	1987	1522953	1999	1850328	2011	2816474
1975	1204186	1987	1528384	1999	1865054	2011	2832667
1975	1213827	1987	1533962	1999	1885422	2011	2841114
1975	1223835	1987	1552793	1999	1906156	2011	2862777
1976	1239921	1988	1576131	2000	1927597	2012	2874224
1976	1215182	1988	1587322	2000	1945333	2012	2900027
1976	1244094	1988	1608670	2000	1964599	2012	2908700
1976	1235002	1988	1623775	2000	1981313	2012	2921353
1977	1232305	1989	1633832	2001	1994180	2013	2933459
1977	1233489	1989	1640920	2001	2004149	2013	2964554
1977	1228729	1989	1642239	2001	2009472	2013	2978165
1977	1235039	1989	1632076	2001	2024922	2013	3016523
1978	1255347	1990	1633382	2002	2051198	2014	3004756
1978	1279609	1990	1632034	2002	2076037	2014	3012093
1978	1265843	1990	1630663	2002	2093066	2014	3031295
1978	1277364	1990	1632176	2002	2107049	2014	3064215
1979	1299722	1991	1619194	2003	2126547	2015	3077418
1979	1308119	1991	1615540	2003	2136932	2015	3061349
1979	1317882	1991	1614913	2003	2148528	2015	3063049
1979	1344927	1991	1612135	2003	2160922	2015	3065526
1980	1372558	1992	1600838	2004	2193636	2016	3059297
1980	1398651	1992	1591019	2004	2224290	2016	3086443
1980	1422596	1992	1572599	2004	2260660	2016	3093979
1980	1425794	1992	1559236	2004	2284801	2016	3096976
1981	1443502	1993	1573049	2005	2308029	2017	3093305
1981	1475027	1993	1590304	2005	2349448	2017	3115623
1981	1496494	1993	1613196	2005	2381486	2017	3133165
1981	1505830	1993	1625148	2005	2397432	2017	3157045

Appendix B

Dependent Variable: D(LNPCT)
Method: Generalized Method of Moments
Date: 09/30/19 Time: 00:40
Sample (adjusted): 1992 2017
Included observations: 26 after adjustments
Linear estimation with 1 weight update
Estimation weighting matrix: HAC (Bartlett kernel, Newey-West fixed
bandwidth = 3.0000)
Standard errors & covariance computed using estimation weighting matrix
Instrument specification: LNPCT(-3) LNDERDUM(-1) INFCPI(-1)
LNPVTCRDT(-1) LNEXPENDITURE(-1) LNM3(-1)
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPCT(-2)	0.000974	0.000878	1.109278	0.2805
D(LNDERDUM)	-0.005991	0.010524	-0.569287	0.5755
INFCPI	-0.008081	0.001825	-4.427620	0.0003
D(LNPVTCRDT)	-0.210753	0.180787	-1.165753	0.2574
D(LNEXPENDITURE)	0.687316	0.365260	1.881717	0.0745
D(LNM3)	0.065742	0.148527	0.442625	0.6628

R-squared	0.446736	Mean dependent var	0.008757
Adjusted R-squared	0.308420	S.D. dependent var	0.019002
S.E. of regression	0.015802	Sum squared resid	0.004994
Durbin-Watson stat	1.981923	J-statistic	0.041745
Instrument rank	7	Prob(J-statistic)	0.838107

Appendix B1

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	3.562186	Prob. F(2,19)	0.0486
Obs*R-squared	7.363164	Prob. Chi-Square(2)	0.0252

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 09/30/19 Time: 15:42
Sample: 1991 2017

Included observations: 27
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPCT-2	-0.001187	0.004597	-0.258231	0.7990
LNDERDUM	0.001905	0.003918	0.486296	0.6323
INFCPI	0.000532	0.000683	0.778181	0.4460
D(LNPVTCRDT)	0.006646	0.031411	0.211574	0.8347
D(LNEXPENDITURE)	-0.018016	0.061636	-0.292301	0.7732
LNM3	-0.001787	0.006286	-0.284289	0.7793
RESID(-1)	-0.314665	0.208162	-1.511634	0.1471
RESID(-2)	-0.515668	0.208140	-2.477511	0.0228

R-squared	0.272710	Mean dependent var	-3.83E-06
Adjusted R-squared	0.004760	S.D. dependent var	0.006536
S.E. of regression	0.006521	Akaike info criterion	-6.986475
Sum squared resid	0.000808	Schwarz criterion	-6.602523
Log likelihood	102.3174	Hannan-Quinn criter.	-6.872306
Durbin-Watson stat	1.980271		

Appendix C

Dependent Variable: D(LNPCPT)

Method: Least Squares

Date: 11/26/18 Time: 23:30

Sample (adjusted): 1993 2017

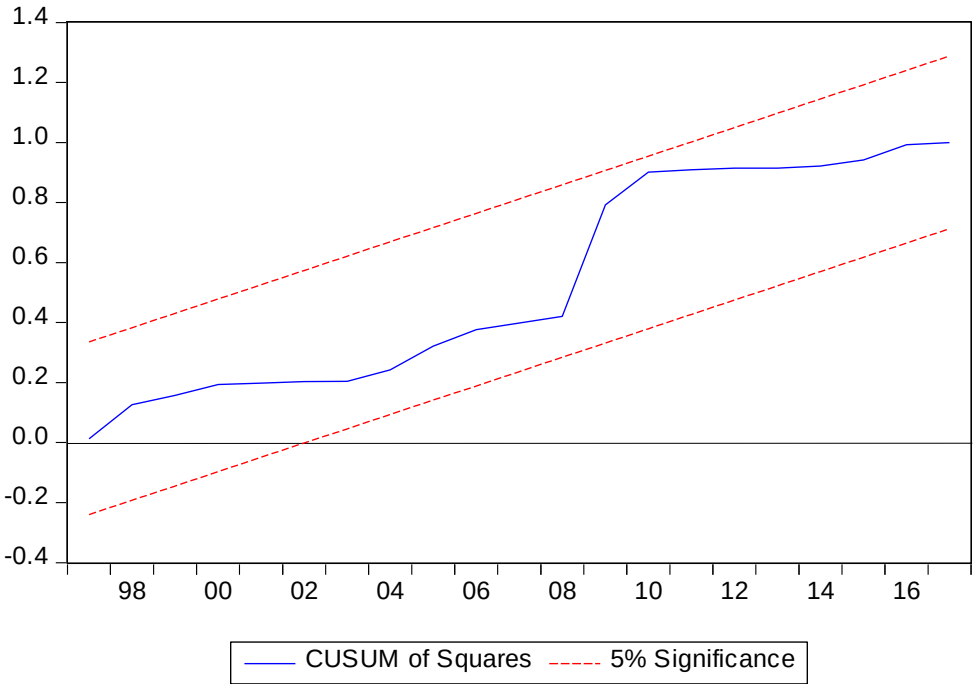
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003838	0.006570	0.584162	0.5653
D(LNPCPT(-1))	0.604642	0.337958	1.789102	0.0880
D(LNDERVALUE(-1))	0.006882	0.015564	0.442181	0.6629
ECM1(-1)	-0.368435	0.473952	-0.777368	0.4456

R-squared	0.220270	Mean dependent var	0.010807
Adjusted R-squared	0.108881	S.D. dependent var	0.016195
S.E. of regression	0.015288	Akaike info criterion	-5.377861

Sum squared resid	0.004908	Schwarz criterion	-5.182840
Log likelihood	71.22326	Hannan-Quinn criter.	-5.323770
F-statistic	1.977472	Durbin-Watson stat	1.769983
Prob(F-statistic)	0.148248		

Appendix C1



Appendix C2

Dependent Variable: D(LNDERVALUE)

Method: Least Squares

Date: 11/27/18 Time: 00:07

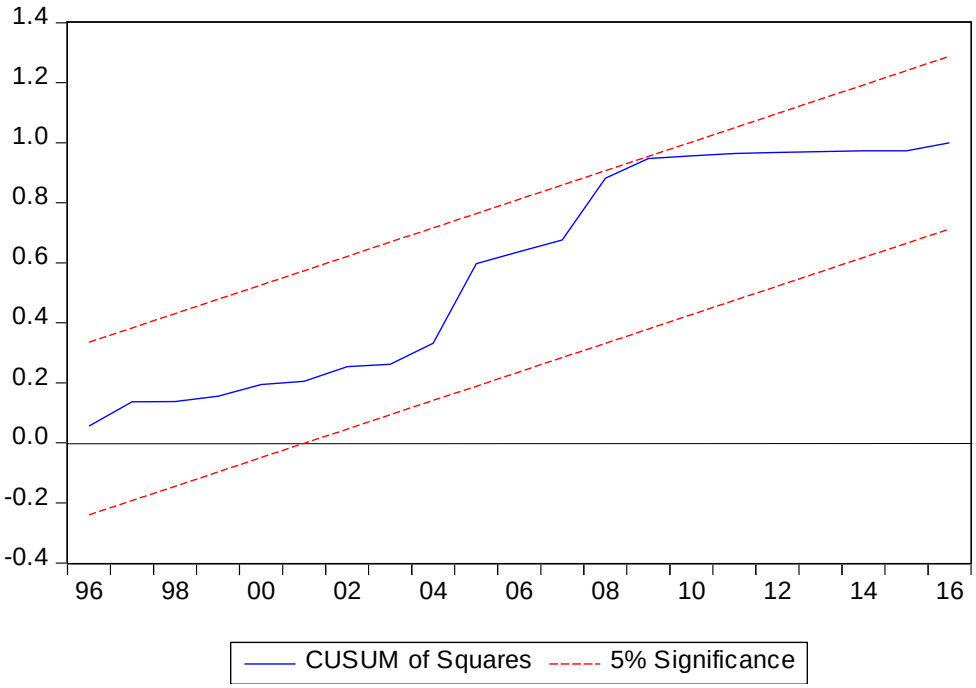
Sample (adjusted): 1992 2016

Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.046192	0.089868	-0.514001	0.6126
D(LNDERVALUE(-1))	0.985903	0.266814	3.695087	0.0013
D(LNPCPT(-1))	2.262506	3.183890	0.710611	0.4851
ECM2(-1)	-0.987355	0.421939	-2.340040	0.0292

R-squared	0.430985	Mean dependent var	0.196832
Adjusted R-squared	0.349697	S.D. dependent var	0.269458
S.E. of regression	0.217295	Akaike info criterion	-0.069476
Sum squared resid	0.991559	Schwarz criterion	0.125544
Log likelihood	4.868449	Hannan-Quinn criter.	-0.015386
F-statistic	5.301956	Durbin-Watson stat	1.753932
Prob(F-statistic)	0.007035		

Appendix C3



Appendix D1

	COGDP_G1	COGDP_G2
Mean	0.006065	0.006109
Median	0.006978	0.006666
Maximum	0.034579	0.018557
Minimum	-0.021367	-0.015677
Std. Dev.	0.011488	0.006602
Skewness	-0.185715	-0.649564
Kurtosis	2.650536	3.437566
Jarque-Bera	0.910299	8.456382
Probability	0.634353	0.014579
Sum	0.509471	0.659722
Sum Sq. Dev.	0.010954	0.004663
Observations	84	108

Appendix D2

Test for Equality of Variances Between Series

Date: 12/01/18 Time: 21:01

Sample: 1 108

Included observations: 108

Method	df	Value	Probability
F-test	(83, 107)	3.028101	0.0000
Siegel-Tukey		4.572240	0.0000
Bartlett	1	28.43147	0.0000
Levene	(1, 190)	27.81028	0.0000
Brown-Forsythe	(1, 190)	26.81404	0.0000

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.50E-05	1.24E-05	3.629609	0.0004
RESID^2(-1)	0.193507	0.071670	2.699983	0.0076
RESID^2(-2)	0.050857	0.073024	0.696445	0.4870
RESID^2(-3)	0.104693	0.071594	1.462305	0.1454

Notes: R squared 0.0647 Adjusted R squared 0.049 Observations 189 F=4.271 Significance F=0.006

Appendix E

Garch(1,1) Result

Dependent Variable: COGDP_G
Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date: 12/01/18 Time: 03:50
Sample (adjusted): 1970Q2 2017Q4
Included observations: 191 after adjustments
Convergence achieved after 53 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1) + C(6)*DUMMY

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.006491	0.000883	7.350329	0.0000
AR(1)	0.464284	0.069752	6.656210	0.0000
Variance Equation				
C	1.22E-05	1.13E-05	1.077432	0.2813
RESID(-1)^2	0.074684	0.045783	1.631278	0.1028
GARCH(-1)	0.816987	0.101276	8.066957	0.0000

DUMMY	-9.63E-06	9.59E-06	-1.003191	0.3158

R-squared	0.035428	Mean dependent var	0.006069
Adjusted R-squared	0.030325	S.D. dependent var	0.009062
S.E. of regression	0.008923	Akaike info criterion	-6.937940
Sum squared resid	0.015050	Schwarz criterion	-6.835774
Log likelihood	668.5732	Hannan-Quinn criter.	-6.896558
Durbin-Watson stat	2.485624		

Inverted AR Roots	.46